SHOUT
SHARE
IT

221

Science
A

17

9587

I

BULLETIN

OF THE

American Museum of Natural History.

Vol. XXIV, 1908.

LIBRARY
UNIVERSITY OF TORONTO

EDITOR, J. A. ALLEN.

148844
5/3/19

NEW YORK:
Published by order of the Trustees.
1908.

FOR SALE AT THE MUSEUM.

QH
1
A4
v. 24

American Museum of Natural History

Seventy-Seventh Street and Central Park West, New York City

OFFICERS.

President.
HENRY FAIRFIELD OSBORN.
First Vice-President.
J. PIERPONT MORGAN.
Second Vice-President.
CLEVELAND H. DODGE.
Treasurer.
CHARLES LANIER.
Secretary.
J. HAMPDEN ROBB.
Director.
HERMON C. BUMPUS.
Assistant Secretary and Assistant Treasurer.
GEORGE H. SHERWOOD.

BOARD OF TRUSTEES.

Class of 1908.
H. O. HAVEMEYER.
A. D. JUILLIARD.
FREDERICK E. HYDE.
GEORGE S. BOWDOIN.
CLEVELAND H. DODGE.

Class of 1909.
JOSEPH H. CHOATE.
J. PIERPONT MORGAN.
GEORGE G. HAVEN.
HENRY F. OSBORN.

Class of 1910.
J. HAMPDEN ROBB.
ARTHUR CURTISS JAMES.
PERCY R. PYNE.
JOHN B. TREVOR.

Class of 1911.
CHARLES LANIER.
ANSON W. HARD.
WILLIAM ROCKEFELLER.
GUSTAV E. KISSEL.
SETH LOW.

Class of 1912.
D. O. MILLS.
ARCHIBALD ROGERS.
ALBERT S. BICKMORE.
CORNELIUS C. CUYLER.
ADRIAN ISELIN, JR.

Scientific Staff.

DIRECTOR.

Hermon C. Bumpus, Ph.D., Sc. D.

DEPARTMENT OF PUBLIC INSTRUCTION.

Prof. Albert S. Bickmore, B. S., Ph.D., LL.D., Curator Emeritus.
George H. Sherwood, A.B., A.M., Curator.

DEPARTMENT OF GEOLOGY AND INVERTEBRATE PALÆONTOLOGY.

Prof. R. P. Whitfield, A.M., Curator.
Edmund Otis Hovey, A.B., Ph.D., Associate Curator.

DEPARTMENT OF MAMMALOGY AND ORNITHOLOGY.

Prof. J. A. Allen, Ph.D., Curator.
Frank M. Chapman, Associate Curator.

DEPARTMENT OF VERTEBRATE PALÆONTOLOGY.

Prof. Henry Fairfield Osborn, A.B., Sc.D., LL.D., D.Sc., Curator.
W. D. Matthew, Ph.B., A.B., A.M., Ph.D., Associate Curator.
Walter Granger, Assistant.
Barnum Brown, A.B., Assistant.

Prof. Bashford Dean, A.B., A.M., Ph.D., Curator of Fossil Fishes.
Louis Hussakof, B. S., Ph.D., Assistant.

DEPARTMENT OF ETHNOLOGY.

Clark Wissler, A.B., A.M., Ph.D., Curator.
Harlan I. Smith, Assistant Curator.
George H. Pepper, Assistant.
Charles W. Mead, Assistant.

Prof. Marshall H. Saville, Honorary Curator of Mexican Archæology.

DEPARTMENT OF ENTOMOLOGY.

William Beutenmüller, Curator.

DEPARTMENTS OF MINERALOGY AND CONCHOLOGY.

L. P. Gratacap, Ph.B., A.B., A.M., Curator.
George F. Kunz, A.M., Ph.D., Honorary Curator of Gems.

DEPARTMENT OF BOOKS AND PUBLICATIONS

Prof. Ralph W. Tower, A.B., A.M., Ph.D., Curator.

DEPARTMENT OF INVERTEBRATE ZOÖLOGY.

Prof. William Morton Wheeler, Ph.D., Curator.
Roy W. Miner, A.B., Assistant Curator.
B. E. Dahlgren, D.M.D., Assistant Curator.

DEPARTMENT OF PHYSIOLOGY.

Prof. Ralph W. Tower, A.B., A.M., Ph.D., Curator.

DEPARTMENT OF MAPS AND CHARTS.

A. Woodward, Ph.D., Curator.

CONTENTS OF VOLUME XXIV.

PAGE

Title-page i

Officers and Trustees iii

Scientific Staff iv

Contents vii

Dates of Publication of Author's Separates ix

List of Illustrations ix

List of New Names of Higher Groups, Genera, Species, and Subspecies xii

ART. I.— A List of the Genera and Subgenera of North American Birds, with their Types, According to Article 30 of the International Code of Zoölogical Nomenclature. By J. A. ALLEN 1

II.— Notes and Observations on Carboniferous Fossils and Semi-fossil Shells, Brought Home by Members of the Peary Expedition of 1905–1906. By R. P. WHITFIELD. (Plates I–IV) 51

III.— Fossil Insects from Florissant, Colorado. By T. D. A. COCKERELL. (Plate V) 59

IV.— The Fossil Flora of Florissant, Colorado. By T. D. A. COCKERELL. (Plates VI–X) 71

V.— Pennant's 'Indian Zoology.' By J. A. ALLEN 111

VI.— The Ants of Porto Rico and The Virgin Islands. By WILLIAM MORTON WHEELER. (Plates XI–XII) 117

VII.— The Ants of Jamaica. By WILLIAM MORTON WHEELER 159

VIII.— Ants from Moorea, Society Islands. By WILLIAM MORTON WHEELER 165

IX.— Ants from the Azores. By WILLIAM MORTON WHEELER 169

X.— Notes upon the External and Internal Anatomy of *Balæna glacialis* Bonn. By ROY C. ANDREWS. (Six text figures.) 171

XI.— A Four-horned Pelycosaurian from the Permian of Texas. By W. D. MATTHEW. (One text figure.) 183

XII.— The Ankylosauridæ, a New Family of Armored Dinosaurs from the Upper Cretaceous. By BARNUM BROWN. (Twenty text figures.) 187

XIII.— Description of a New Species of *Mesoplodon* from Canterbury Province, New Zealand. By ROY C. ANDREWS. (Plate XIII, and five text figures.) 203

XIV.— Notes on Two Porpoises Captured on a Voyage into the Pacific Ocean. By JOHN TREADWELL NICHOLS. (Plate XIV, and three text figures.) 217

XV.— A Revision of the American Eocene Horses. By WALTER GRANGER. (Plates XV–XVIII, and five text figures.) 221

XVI.— New Fossil Mammals from the Fayum Oligocene, Egypt. By HENRY FAIRFIELD OSBORN. (Six text figures.) 265

PAGE

XVII.— Two Fossil Phoridæ from the Miocene Shales of Florissant, Colorado. By CHARLES T. BRUES. (Two text figures.) ... 273

XVIII.— The North Atlantic Right Whale and its near Allies. By J. A. ALLEN. (Plates XIX–XXIV, and one text figure.) 277

XIX.— A Review of the Manakins of the Genus *Chiroxiphia*. By W. DEWITT MILLER. (Plate XXV, colored.) 331

XX.— Honey Ants, with a Revision of the American *Myrmecocysti*. By WILLIAM MORTON WHEELER. (Twenty-eight text figures.) 345

XXI.— The Ants of Texas, New Mexico and Arizona. By WILLIAM MORTON WHEELER. (Plates XXVI–XXVII) 399

XXII.— The Peary Caribou (*Rangifer pearyi* Allen). By J. A. ALLEN. (Twelve text figures.) 487

XXIII.— Notes on *Solenodon paradoxus* Brandt. By J. A. ALLEN. (Plates XXVIII–XXXIII, and nine text figures.) 505

XXIV.— A Fossil Larrid Wasp. By S. A. ROHWER 519

XXV.— On the Tenthredinoidea of the Florissant Shales. By S. A. ROWHER. (One text figure.) 521

XXVI.— Notes on the Skull of *Lysorophus tricarinatus* Cope. By E. C. CASE. (Four text figures.) 531

XXVII.— Osteology of *Blastomeryx* and Phylogeny of the American Cervidæ. By W. D. MATTHEW. (Fifteen text figures.) ... 535

XXVIII.— Myriopoda from Porto Rico and Culebra. By FILIPPO SILVESTRI. (Eleven text figures.) 563

XXIX.— Mammalogical Notes.— I–VI. By J. A. ALLEN. (Four text figures.) 579

XXX.— The Tertiary Tenthredinoidea of the Expedition of 1908 to Florissant, Colo. By S. A. ROHWER. (One text figure.) 591

XXXI.— A Fossil Mellinid Wasp. By S. A. ROHWER 597

XXXII.— New or Little Known Titanotheres from the Eocene and Oligocene. By HENRY FAIRFIELD OSBORN. (Twenty-one text figures.) 599

XXXIII.— The Ants of Casco Bay, with Observations on two Races of *Formica sanguinea* Latreille. By WILLIAM MORTON WHEELER 619

XXXIV.— Mammals from Nicaragua. By J. A. ALLEN. (Twelve text figures.) 647

Index 671

DATES OF PUBLICATIONS OF AUTHOR'S SEPARATES.

The edition of author's separates is 300 copies, of which about 175 are mailed on the date of issue, and the others placed on sale in the Library.

Art. I, Dec. 26, 1907.
" II, " 26, 1907.
" III, Feb. 7, 1908.
" IV, " 7, 1908.
" V, " 7, 1908.
" VI, " 7, 1908.
" VII, " 7, 1908.
" VIII, " 7, 1908.
" IX, " 7, 1908.
" X, " 20, 1908.
" XI, " 13, 1908.
" XII, " 13, 1908.
" XIII, " 26, 1908.
" XIV, " 26, 1908.
" XV, March 25, 1908
" XVI, " 25, 1908
" XVII, " 25, 1908.

Art. XVIII, April, 8, 1908.
" XIX, May 2, 1908.
" XX, " 9, 1908.
" XXI, " 20, 1908.
" XXII, " 22, 1908.
" XXIII, June 8, 1908.
" XXIV, " 12, 1908.
" XXV, " 12, 1908.
" XXVI, " 30, 1908.
" XXVII, " 30, 1908.
" XXVIII, August 25, 1908.
" XXIX, Sept. 11, 1908.
" XXX, " 11, 1908.
" XXXI, " 11, 1908.
" XXXII, " 19, 1908.
" XXXIII, " 25, 1908.
" XXXIV, Oct. 13, 1908.

LIST OF ILLUSTRATIONS.

Plates.

I–III.— Arctic Fossils.
IV.— Semifossil Shells.
V.— Fossil Insects, Florissant, Col.
VI–X.— Fossil Plants, Florissant, Col.
XI and XII.— Porto Rican Ants.
XIII.— *Mesoplodon bowdoini* sp. nov.
XIV.— *Tursiops* sp.
XV.— Wasatch and Lower Bridger Horses.
XVI and XVII.— Bridger Horses.
XVIII.— Upper Bridger and Uinta Horses.
XIX–XXIV.— *Eubalæna glacialis* (Bonn.).
XXV.— *Chiroxiphia boliviana* and *C. napensis.*
XXVI and XXVII.— Ants of Texas, New Mexico and Arizona.
XXVIII.— *Solenodon paradoxus.* (Group at Museum.)
XXIX–XXXI.— *Solenodon paradoxus* and *S. cubanus.* (Skulls.)
XXXII and XXXIII.— *Solenodon paradoxus*, milk dentition.

Text Figures.

PAGE
Group of *Cecropia peltata* L. 120
“ “ “ “ showing foliage perforated by insects 121
Nest of *Iridomyrmex melleus* 152
Carton diaphragms of *Camponotus sexguttatus* 157
Model of Amagansett whale 173
Inferior surface of pectoral fin of Amagansett whale 174
First caudal vertebra of Amagansett whale 176
Right carpus of Wainscott whale 180
Sternum of Amagansett whale 181
Skull of *Triceratops insignis*, lateral view 183
Aukylosaurus magniventris, top of skull 190
“ “ tooth (type of genus and species) 191
Palæocinctus costatus, tooth (type of genus and species) 191
Stereocephalus tutus, tooth 192
Aukylosaurus magniventris, 5th (?) and 7th (?) vertebræ 193
“ “ 15th dorsal vertebra 194
“ “ 19th “ “ 194
“ “ 9th (?) caudal vertebra 195
“ “ anterior dorsal rib 195
“ “ scapula and coracoid 196
“ “ dermal plates 197
“ “ restoration of dermal armature 198
“ “ restoration of axial skeleton and girdles 199
“ “ restoration of skeleton 200
Mesoplodon bowdoini, tympanic and periotic bones 207
“ “ side view of right ramus 207
“ “ top view of mandible 208
“ “ skeleton 209
“ “ left scapula 214
Tursiops sp., animal, from photograph 217
“ side view of head, from photograph 218
Lagenorhynchus cruciger, animal, from photograph 219
Eohippus resartus, upper and lower molars, crown view 241
“ *venticolus*, upper teeth, side and crown views 260
Development of internal cusps on upper premolars in four stages of Eocene Horses 261
Outlines of lower cheek teeth of Equidæ 263
Ptolemaïa lyonsi, left mandibular ramus, three views 266
“ “ superior and internal views of lower teeth 267
Phiomys andrewsi, right mandibular ramus 269
Metaphiomys beadnelli, part of left mandibular ramus 270
Apidium phiomensis, part of left mandibular ramus 271
Phora cockerelli, type specimen 274
“ *laminarum*, “ “ 275
Eubalæna glacialis, right pelvic bone 329
Map of geographic distribution of species of *Chiroxiphia* 333

PAGE
Map showing distribution of *Myrmecocysti* 347
Myrmecocystus melliger 349
“ “ *orbiceps* 350
“ “ *mendax*, genital valve of male 352
“ “ “ var. *comatus* 352
“ *mexicanus* var. *horti-deorum* 353
“ “ “ repletes 354
“ “ “ worker 355
“ “ “ repletes 357
“ “ “ genital valve of male 359
“ “ *navajo*, worker 360
“ *melliger minicus*, home of, at Yucca, Arizona 363
“ “ “ nest crater, at Tucson, Arizona 365
“ “ *semirufus*, nest crater, Needles, Col. 367
“ “ “ nest crater, Mojave Desert, Arizona 368
Garden of the Gods, Colorado, showing rocky ridges where *Myrmecocystus horti-deorum* nests 370
Shin-oaks in the Garden of the Gods, Colorado 371
Nest craters of *Myrmecocystus horti-deorum*, near Manitou, Colorado 372, 373, 375
Repletes of *Myrmecocystus horti-deorum* hanging from roof of honey chamber 376
Replete of *Myrmecocystus horti-deorum* regurgitating food to workers 377
Galls of *Holcaspis perniciosus* exuding droplets which are collected by workers of *Myrmecocystus horti-deorum* 378
Desert near Albuquerque, New Mexico, home of *Myrmecocystus mexicanus navajo* 380
Nest of *Myrmecocystus mexicanus navajo* 381
Prenolepis (*Nylanderia*) *imparis*, worker and replete 384
Cremastogaster inflata, worker 391
Rangifer pearyi, skull and antlers of male, front view 494
“ “ “ “ “ “ “ side view 495
“ “ “ “ “ “ “ front view 496
“ “ “ “ “ “ “ side view 497
“ “ “ “ “ “ “ front view 498
“ “ “ “ “ “ “ side view 499
“ *arctica* “ “ “ “ “ side view 500
“ “ “ “ “ “ “ front view 501
“ “ “ “ “ “ “ side view 502
“ “ “ “ “ “ “ front view 503
“ *pearyi* “ “ “ “ female, two views 504
Solenodon paradoxus, side view of head of old male 507
“ “ three views of proboscis 508
“ “ palatal surface 508
“ “ left fore foot, from below 509
“ “ left hind foot, from below 509
“ “ male and female genitalia 511
“ “ glandular surface of left thigh 513
“ “ hyoid bones and ossified larynx 516
Phenacoperga clavatus, fore wing 527
“ *coloradensis*, radial cell, etc 527

PAGE

Lysorophus tricarinata, skull, four views 532
Blastomeryx primus, side view of skull of type 537
“ *olcotti*, upper canine 538
“ “ lower jaw and crown view of teeth 539
“ *advena* “ “ “ “ “ “ “ 540
“ *primus*, basicranial region of skull of type 540
“ “ restoration of skeleton 541
“ *olcotti*, hind foot 543
Leptomeryx evansi, side view of skull 544
“ “ fore foot 545
“ “ hind foot 545
Phylogeny of American Cervidæ: side view of skulls of *Leptomeryx evansi*, *Blastomeryx primus* and *Mazama nemorivaga* 547
Phylogeny of American Cervidæ: crown surface of teeth of *Mazama nemorivaga*, *Blastomeryx primus*, *B. olcotti*, *Leptomeryx* sp., and *L. evansi* 548
Phylogeny of American Cervidæ: fore feet of *Leptomeryx evansi*, *Blastomeryx evansi*, and *Mazama nemorivaga* 550
Phylogeny of American Cervidæ; hind feet of same species as in preceding figures 551
Evolution and migration of American Cervidæ (diagram) 558
Phylogeny of American Ruminants (diagram) 559
Geophilus culebræ, head and details 565
Diopsiulus compressus, structural details 567
“ *wheeleri*, structural details 568
Rhinocricus arboreus var. *gundlachi*, antenna and copulatory apparatus 569
“ *modestior*, antenna and copulatory apparatus 570
Microspirobolus marmoratus, hypostoma, antenna, and copulatory apparatus 571
“ *insularis*, copulatory apparatus 573
Orthoparus sculpturatus, structural details 574
Lasiodesmus caraibicus, structural details 576
Tridesmus portoricensis, structural details 577
Artibeus quadrivittatus, skull, outside view, showing fused premolars 579
“ “ right upper toothrow, normal, outside view 580
“ “ left upper toothrow, inside view, showing fused premolars 580
“ “ right upper toothrow, normal, inside view 580
Nortonella typica, fore wing, type 593
Lambdotherium popoagicum, fore limb and teeth 600
Eotitanops borealis, type (teeth) 601
Limnohyops priscus, type (teeth) 602
“ *matthewi*, side view of skull of type 602
“ *monoconus*, lower view of skull (type) 603
Palæosyops leidyi, lower view of skull of type 605
“ *grangeri*, upper dentition of type 605
“ *copei*, upper grinding teeth of type 606
Manteoceros washakiensis, side view of type skull 607
Mesatirhinus petersoni, top view of type skull 608
Metarhinus fluviatilis, side view of type skull 609
“ *fluviatilis*, top view of type skull 610

PAGE
Dolichorhinus, intermedius, top view of type skull 611
“ *hyognathus,* restoration of skeleton 612
Telmatherium ultimum, side view of type skull 613
“ (?) *altidens,* side view of lower jaw, type 614
Protitanotherium superbum, side view of lower jaw, type 615
Brontotherium hatcheri, top view of type skull 616
Symborodon copei, side view of type skull 617
Hoplomys truei, upper dentition of type 650
“ “ lower dentition of type 651
Proechimys trinitatis, upper dentition of type 650
“ “ lower dentition of type 651
Bassaricyon richardsoni, side view of type skull 663
“ “ top “ “ “ “ 664
“ “ lower “ “ “ “ 665
“ “ “ jaw “ “ “ 666
“ *gabbi,* side view of type skull 663
“ “ top “ “ “ “ 664
“ “ lower “ “ “ “ 665
“ “ lower jaw “ “ “ 666

LIST OF FAMILIES, GENERA, SPECIES, SUBSPECIES AND VARIETIES FIRST DESCRIBED OR RENAMED IN THIS VOLUME.

FAMILIES.

PAGE
Ankylosauridæ Brown 187
Ptolemaiidæ Osborn 267

GENERA AND SUBGENERA.

Arctitreta Whitfield 57
Lithogryllites Cockerel 64
Tetraceratops Matthew 183
Ankylosaurus Brown 188
Aminippus (subgenus) Granger 254
Ptolemaïa Osborn 267
Phiomys Osborn 269
Apidium Osborn 271
Lasiodesmus Silvestri 575
Pseudocimbex Rohwer 526
Lisconeura Rohwer 529

PAGE
Nortonella Rohwer 592
Mesatirhinus Osborn 608
Metarhinus Osborn 609
Hoplomys Allen 649

SPECIES AND SUBSPECIES.

Syringothyris arctica Whitfield 53
Productus semireticulatus arctica Whitfield 55
Arctibreta pearyi Whitfield 57
Polystæchotes piperatus Cockerell 59
Panorpa arctiiformis Cockerell 59
Agrion telluris Cockerell 60
Phenacolestes mirandus Cockerell 61
“ *parallelus* Cockerell 62
Anabrus caudelli Cockerell 63
Lithogryllites lutzii Cockerell 64
Cecidomyia (?) *pontaniiformis* Cockerell 66
Nymphalites scudderi Beutenmüller & Cockerell 67
Necrodes primævus Beutenmüller & Cockerell 67
Dryobius miocenicus Beutenmüller & Cockerell 68
Phymatodes volans Beutenmüller & Cockerell 68
Ereophyes (?) *beutenmülleri* Cockerell 68
Chara peritula Cockerell 75
Didymosphæria betheli Cockerell 75
Onoclea reducta Cockerell 76
Dryopteris scansa Cockerell 76
Woodwardia florissantia Cockerell 77
Pellæa antiquella Cockerell 77
Pinus wheeleri Cockerell 78
Heyderia coloradensis Cockerell 78
Stipa laminarum Cockerell 79
Juncus crassulus Cockerell 79
Hicoria princetonia Cockerell 80
Juglans (?) *sepulta* Cockerell 80
Salix ramaleyi rohweri Cockerell 82
Populus (?) *pseudocredneria* Cockerell 83
Alnus præcordata Cockerell 84
Quercus lyratiformis Cockerell 85
“ *peritula* Cockerell 85
“ *balinorum* Cockerell 86
Castanea dolichophylla Cockerell 87
Morus symmetrica Cockerell 88
Ficus florissantella Cockerell 88
“ *arenaceæformis* Cockerell 89
“ *navicularis* Cockerell 89
Aristolochia mortua Cockerell 90
Odostemon florissantensis Cockerell 91

	PAGE
Persea coloradica Cockerell	91
Saxifraga (?) *peritula* Cockerell	92
Philadelphus palæophilus Cockerell	92
Hydrangea (?) *subincerta* Cockerell	92
Ribes protomelænum Cockerell	93
Weinmannia phenacophylla Cockerell	93
" *lesquereuxi* Cockerell	93
" (?) *dubiosa* Cockerell	94
Liquidamber convexum Cockerell	94
Rosa wilmattæ Cockerell	94
Amelanchier peritula Cockerell	95
Sorbus megaphylla Cockerell	95
Lucæna coloradensis Cockerell	96
Viborquia nigrostipellata Cockerell	97
Fagara (?) *delicatula* Cockerell	98
Ptelea modesta Cockerell	98
Melia (?) *expulsa* Cockerell	98
Pachistima (?) *integra* Cockerell	100
Sapindus coloradensis Cockerell	101
" *leonis* Cockerell	102
Paliurus haydeni Cockerell	102
Vitis florissantella Cockerell	102
" *alaskana* Cockerell	103
Parthenocissus osborni Cockerell	103
Buettneria (?) *perplexans* Cockerell	104
Oxypolis destructis Cockerell	105
Andromeda scudderiana Cockerell	105
Myrsine laminarum Cockerell	105
Dyospyros princetonia Cockerell	105
Fraxinus palæophyla Cockerell	106
Mimulus saxorum Cockerell	107
Sicyos (?) *florissantia* Cockerell	107
Melothria (?) *coloradensis* Cockerell	108
Aster florissantia Cockerell	108
Cardiocondyla venustula Wheeler	128
Solenopsis globularia var. *borinquensis* Wheeler	131
" *azteca* var. *pallida* Wheeler	131
Pheidole subarmata var. *borinquensis* Wheeler	133
" *mærens* Wheeler	136
Macromischa isabellæ Wheeler	138
" *albispina* Wheeler	139
Strumigenys louisianæ var.-*obscuriventris* Wheeler	145
Iridomyrmex melleus Wheeler	151
" " *fuscescens* Wheeler	153
Myrmelachista ambigua ramulorum Wheeler	155
Pheidole punctatissima jamaicensis Wheeler	161
Cremastogaster vicina var. *wighti* Wheeler	161
Rhopalothrix simoni var. *wighti* Wheeler	161
Camponotus capperi corticalis var. *subdepilis* Wheeler	163

Page

Plagiolepis mactavishi Wheeler 166
Tetraceratops insignis Matthew 183
Ankylosaurus magniventris Brown 188
Mesoplodon bowdoini Andrews 203
Eohippus resartus Granger 240
“ *borealis* Granger 242
Orohippus typicus Granger 249
“ *progressus* Granger 250
“ *atavus* Granger 253
Epihippus parvus Granger 258
Ptolemaïa lyonsi Osborn 267
Phiomys andrewsi Osborn 269
Metaphiomys beadnelli Osborn 270
Apidium phiomensis Osborn 271
Phora cockerelli Brues 274
“ *laminarum* Brues 275
Chiroxiphia napensis Miller 338
Myrmecocystus melliger orbiceps Wheeler 349
“ “ *mendax* Wheeler 351
“ “ “ var. *comatus* Wheeler 352
“ “ *mimicus* Wheeler 353
“ “ “ var. *jesuita* Wheeler 354
“ “ “ var. *depilis* Wheeler 354
“ *mexicanus navajo* Wheeler 360
“ *mexicanus mojave* Wheeler 366
Eciton (*Acamatus*) *arizonense* Wheeler 414
“ “ *oslari* Wheeler 415
Myrmecina graminicola texana Wheeler 422
Solenopsis geminata var. *diabola* Wheeler 424
“ *pilosula* Wheeler 426
“ *salina* Wheeler 427
“ *krockowi* Wheeler 428
Pheidole proserpina Wheeler 437
“ *soritis* Wheeler 439
“ *sitarches* Wheeler 440
“ “ var. *transvarians* Wheeler 442
“ “ *rufescens* Wheeler 443
“ “ “ var. *campestris* Wheeler 443
“ *sciophila* Wheeler 443
“ *xerophila* Wheeler 446
“ “ *tucsonica* Wheeler 448
“ “ “ var. *gilvescens* Wheeler 448
“ *barbarta* Wheeler 448
“ *macclendoni* Wheeler 448
“ *rhea* Wheeler 452
“ *vinelandica buccalis* Wheeler 454
“ *casta* Wheeler 454
“ *humeralis* Wheeler 456
“ *marcidula* Wheeler 457

PAGE

Pheidole pinealis Wheeler 459
“ *morrisi* var. *impexa* Wheeler 461
“ *hyatti* var. *ecitonodora* Wheeler 463
“ *cockerelli* Wheeler 464
“ *crassicornis porcula* Wheeler 466
“ “ “ var. *tetra* Wheeler 467
“ “ var. *diversipilosa* Wheeler 467
“ *constipata* Wheeler 468
“ *lauta* Wheeler 470
“ *nuculiceps* Wheeler 473
“ *metallescens splendidula* Wheeler 474
Crematogaster lineolata opaca var. *depilis* Wheeler 478
“ “ var. *clara* 481
“ *arizonensis* Wheeler 482
Pison cockerellæ Rohwer 519
“ *oligocenum* Rohwer 520
Neurotoma cockerelli Rohwer 523
Palæotaxonus trivittatus Rohwer 524
Pseudocimbex clavatus Rohwer 528
Fenusa primula Rohwer 528
Dineura cockerelli Rohwer 530
Blastomeryx primus Matthew 543
“ *olcotti* Matthew 543
Geophilus culebræ Silvestri 564
Diopsiulus wheeleri Silvestri 568
Rhinocricus modestior Silvestri 570
Microspirobolus marmoratus Silvestri 571
“ *insularis* Silvestri 572
Lasiodesmus caraibicus Silvestri 576
Tridesmus portoricensis Silvestri 577
Ardops haitiensis Allen 581
Molossus verrilli Allen 581
Schizocerus konowi Rohwer 591
Eriocampa bruesi Rohwer 592
Nortonella typica Rohwer 593
Dineura fuscipennis Rohwer 593
Tenthredo saxorum Rohwer 594
Mellinus handlirschi Rohwer 597
Limnohyops priscus Osborn 601
“ *matthewi* Osborn 602
“ *monoconus* Osborn 603
Palæosyops leidyi Osborn 604
“ *grangeri* Osborn 605
“ *copei* Osborn 606
Manteoceras washakiensis Osborn 607
Mesatirhinus petersoni Osborn 608
Metarhinus fluviatilis Osborn 609
“ *earlei* Osborn 610
Dolichorhinus intermedius Osborn 611

PAGE
Telmatherium ultimum Osborn 613
“ (?) *altidens* Osborn 614
Protitanotherium superbum Osborn 615
Brontotherium hatcheri Osborn 615
Symborodon copei Osborn 616
Lepus gabbi tumacus Allen 649
Hoplomys truei Allen 650
Heteromys vulcani Allen 652
“ *fuscatus* Allen 652
Neotoma chrysomelas Allen 653
Peromyscus nicaraguæ Allen 658
Oryzomys alfaroi incertus Allen 655
“ *ochraceus* Allen 655
“ *carrikeri* Allen 656
Sigmodon hispidus griseus Allen 657
Ototylomys fumeus Allen 658
Sciurus deppei matagalpæ Allen 660
Lutra latidens Allen 660
Tayra barbara inserta Allen 662
Bassaricyon richardsoni Allen 662
Blarina olivaceus Allen 669
Artibeus jamaicensis richardsoni Allen 669
Alouatta palliata matagalpæ Allen 670

BULLETIN

OF THE

AMERICAN MUSEUM OF NATURAL HISTORY.

VOLUME XXIV, 1908.

59.82(7)

Article I.— A LIST OF THE GENERA AND SUBGENERA OF NORTH AMERICAN BIRDS, WITH THEIR TYPES, ACCORDING TO ARTICLE 30 OF THE INTERNATIONAL CODE OF ZOÖLOGICAL NOMENCLATURE.

BY J. A. ALLEN.

I. INTRODUCTORY.

In a previous volume of this Bulletin (Vol. XXIII, pp. 279–384, April 15, 1907) I published a paper entitled 'The Types of the Genera of North American Birds,' in which the types of the originally typeless polytypic genera were determined in accordance with the rule of priority, or by the so-called method of elimination.

This investigation was undertaken for the purpose of determining the truth or fallacy of certain allegations regarding the results of type-determination by the method of elimination,[1] namely: (1) That the types of many of the genera of North American birds as designated by a Committee of the American Ornithologists' Union, mainly in 1886, on the principle of elimination, were erroneously determined and should be changed; (2) that this method of determining types of genera is unsatisfactory, it being claimed that there are several different ways of 'eliminating,' and that in difficult cases different eliminators rarely reach the same results; (3) that the determination of genotypes by the 'first species rule' requires little or no research and the results are necessarily always uniform; (4) that the number of changes in generic names necessary in order to correct the errors in the A. O. U. Check-List due to faulty elimination were about equal to the number that would be required under the first species rule.

---

[1] The following recent papers on the determination of types of genera, with special reference to the first species rule, published mainly in 'Science,' N. S., Vols. XXI–XXVI, are of interest.

1. Nomenclature in Ichthyology. A Provisional Code Based on the Code of the American Ornithologists' Union. "Under the joint authorship of Doctors Jordan, Evermann and Gilbert." Condor, VII, Jan. 1905, pp. 28–30.
2. A New Code of Nomenclature. By J. A. Allen. Science, N. S., XXI, No. 533, pp. 428–433, March 17, 1905. In relation to the foregoing.
3. The Relative Merits of the 'Elimination' and 'First Species' Method in Fixing the Types of Genera — with Special Reference to Ornithology. By Witmer Stone. Science, N. S., XXIV, No. 618, pp. 560–565, Nov. 2, 1906.
4. The 'Elimination' and 'First Species' Methods of Fixing the Types of Genera. By J. A. Allen. Science, N. S., XXIV, No. 624, pp. 773–779, Dec. 14, 1906. A reply to No. 3.
5. Elimination in Fixing Genotypes. By F. A. Bather. Science, N. S., XXIV, No. 625, pp. 809, 810, Dec. 21, 1906.
6. The 'First Species Rule' vs. the 'Law of Priority' in determining the Types of Genera. By Ch. Wardell Stiles. Science, N. S., XXV, No. 630, pp. 145–147.
7. The First Species Rule versus Elimination. By Witmer Stone, Science, N. S., XXV, No. 630, pp. 147–151, Jan. 25, 1907.
8. Elimination versus the First Species Rule. By D. W. Coquillett. Science, N. S., XXV, No. 634, pp. 308, 309, Feb. 22, 1907.
9. The 'First Species' and the 'First Reviser.' By David Starr Jordan. Science, N. S., XXV, No. 638, pp. 467–469, March 22, 1907.
10. The First Species Rule for determining Types of Genera — How it works in Ornithology. By J. A. Allen. Science, N. S., XXV, No. 640, pp. 546–554, April 5, 1907.
11. The First Species Rule as it affects Genera of North American Birds. By Witmer Stone. Science, N. S., XXV, No. 644, pp. 708, 709, May 3, 1907. A reply to No. 10.
12. The First Reviser and Elimination. By D. W. Coquillett. Science, N. S., XXV, No. 642, pp. 625, 626. April 19, 1907.
13. The First Species Rule. By John B. Smith. Science, N. S., XXV, No. 645, pp. 744, 745. May 10, 1907.

The scope of this paper was restricted to the genera contained in the second (1895) edition of the Check-List and its subsequent supplements, the last of which (the thirteenth) was published in July, 1904, and hence did not include certain additional genera subsequently adopted by the Committee, but as yet not announced. The types dependent upon elimination were determined independently of any previous results reached by others. On comparison of the results thus obtained with the Check-List, it was found that in only four cases was the status of generic names subject to change, and in two of these other conditions than elimination were involved. On the other hand, it was found that under the strict enforcement of the first species rule twenty generic changes would be necessary, eighteen of which have since been tentatively adopted by the A. O. U. Committee. This is on the basis of the exclusion of Linnæan names from the action of the first species rule; their inclusion would increase the number of changes to upward of thirty in a total of about 130 genera involved.

In my recent paper above cited it seemed best to give the original composition of each genus, for the purpose of showing how the species now

---

14. Another Word on the *Vultur* Case. By J. A. Allen. Science, N. S., Vol. XXV, No. 647, p. 827, May 24, 1907.
15. The First Species Rule. By James A. G. Rehn. Science, N. S., XXV, No. 648, p. 870, May 31, 1907.
16. Elimination or First Species. By J. S. Kingsley. Science, N. S., XXV, No. 650, pp. 939, 940, June 14, 1907.
17. The First Species Rule: An Objection. By F. A. Bather, Science, N. S., XXV, No. 651, pp. 670, 671, June 21, 1907.
18. A Necessary Amendment in the Application of the Law of Priority in Zoological Nomenclature. By Thos. H. Montgomery, Jr. Science, N. S., Vol. XXVI, No. 653, pp. 19–21.
19. Another Word on the *Vultur* Case. By Witmer Stone. Science, N. S., XXVI, No. 653, p. 21, July 5, 1907.
20. Dr. Montgomery's proposed Amendment to the Rules of Nomenclature. By William H. Dall. Science, N. S., XXVI, No. 656, p. 117, July 26, 1907.
21. The Rules of Nomenclature. By Arthur Erwin Brown. Science, N. S., XXVI, No. 656, pp. 117, 118, July 26, 1907.
22. The First Species Rule: An Objection. By S. S. Buckman. Science, N. S., XXVI, No. 664, pp. 378, 379, Sept. 20, 1907.
23. The Types of the North American Genera of Birds. By J. A. Allen. Bull. Amer. Mus. Nat. Hist., XXIII, pp. 279–384, April 15, 1907.
24. The Types of the North American Genera of Birds. By Witmer Stone. Science, N. S., XXVI, No. 666, pp. 444–446, Oct. 4, 1907. A criticism of the last.
25. Report of the International Commission on Zoological Nomenclature. By Ch. Wardell Stiles. Science, N. S., XXVI, No. 668, pp. 520–523.
26. Article 30 of the International Code of Zoological Nomenclature. By J. A. Allen. Science, N. S., XXVI, No. 673, pp. 719–723, Nov. 22, 1907.

currently accepted as its type came to be so recognized, and also, in the case of types determined by elimination, the entire basis of the decision. A plea was made for recognition of the work of the first reviser, which the first species rule necessarily ignores, but the first reviser rule, or the rule of 'type by subsequent designation,' was not invoked in my determination of types. A reference was usually made to designations of the first reviser, as information of interest, and I was surprised to find how frequently the type by the first reviser rule, or type by subsequent designation, agreed with type by elimination, as will be noted more fully later.

HISTORICAL RÉSUMÉ.

As time goes on, the importance of strict adherence to authoritative rules of nomenclature becomes more and more apparent. Hence the world-wide welcome accorded the work of the Nomenclature Commission of the International Zoölogical Congress, and the increasing cordiality with which its Code of Nomenclature is received. The time is doubtless now ripe for the acceptance on the part of zoölogists at large of an International Arbitration Commission on Nomenclature which shall not only provide a code of official rules, but be willing to act as arbiter in difficult and complicated cases where experts may reach different conclusions. To most systematists questions of nomenclature are distasteful, and they would gladly accept the decisions of a properly authorized International Commission rather than fritter away valuable time in attempting to solve nomenclatural riddles. Success in this thankless line of work requires natural aptness for such investigations, coupled with long experience and interest in such work. Nine tenths, if not ninety-nine one hundreds, of those who have occasion to use the technical names of animals, have not the time, the inclination, nor the proper training to deal successfully with such problems. Yet their correct solution is of importance to all. The adoption of uniform rules of nomenclature are essential to stability in nomenclature, but if they contravene well-established principles that have become the basis of modern usage they are not likely to meet with general acceptance. Happily the fundamental rules of nomenclature are few, and for many years have been embodied in all modern codes of nomenclature. Matters of detail are of less importance than unanimity of agreement, which may be easily reached by compromise and the waiving here and there of personal preference on minor points.

The nomenclature of to-day, like the sciences of which it is the indispensable servant, has been of slow growth, and prior to the promulgation of the British Association Code in 1842 was without form and to a large extent void. Every man was his own arbiter, and did what seemed to him best, as to sources of names and their application. Subsequent to 1842 there was steady improvement; but old ways are not easily abandoned, and many of the leading zoölogists of that period gave only partial adherence to the B. A. Code, and others gave it no recognition whatever. Few systematists have ever adhered strictly to any code of nomenclature; while observing most of the rules, and applying them nearly always consistently, they have ignored some of them where a little laxness in their application would save an unwelcome change of names. From the publication of the American Ornithologists' Union 'Code of Nomenclature,' in 1886, dates a more rigid adherence to established rules of nomenclature, especially in America. The promulgation in 1905 of an International Code of Nomenclature is evidence of the wide-spread recognition of the importance of adopting uniform rules of nomenclature. The A. O. U. Code and the International Code are in virtual agreement on all points; the former is the more voluminous, treating more at length matters of detail.

The New Article 30 of the International Code.

Since 1905 both codes have been subjected to revision, the A. O. U. Code having been amplified at many points and thus rendered still more explicit, but unfortunately this revision is still unpublished. At the International Zoölogical Congress held in Boston in August, 1907, the Nomenclature Commission of this great representative body of zoölogists included in its report various modifications of the International Code, all in the nature of amplification and clearer definition of rules previously adopted. The chief modification relates to the determination of types of originally typeless genera, as embodied in Article 30. The former Article 30 is cancelled and replaced by a new article, embodying virtually all of the provisions of the original, restated in greater detail, with the addition of a series of recommendations. Its provisions totally exclude appeal to a 'first species rule,' and give the fullest possible recognition to the work of the 'first reviser,' masked under the happy euphemism, "type by subsequent designation." No new principle is introduced; all the provisions of Article 30 are as old as the B. A. Code. The essential rules for type determination of all previous codes are reënacted, in better form than ever before, and with the increased prestige of adoption by an International Congress.

As already stated, Article 30 consists of 'rules' and 'recommendations.' As the latter have only the force of suggestions they need not be further considered in the present connection. The rules offer several points for comment. The essential part of Article 30 is as follows:

"Art. 30.— The designation of type species of genera shall be governed by the following rules (*a–g*), applied in the following order of precedence:

"I. Cases in which the generic type is accepted *solely* upon the basis of the original publication.

"(*a*) When in the original publication of a genus, one of the species is definitely designated as type, this species shall be accepted as type regardless of any other considerations. (Type by original designation.)

"(*b*) If, in the original publication of a genus, *typicus or typus* is used as a *new* specific name for one of the species, such use shall be construed as 'type by original designation.'

"(*c*) A genus proposed with a single original species takes that species as its type. (Monotypical genera.)

"(*d*) If a genus, without originally designated (see *a*) or indicated (see *b*) type, contains among its original species one possessing the generic name as its specific or subspecific name, either as valid name or synonym, that species or subspecies becomes *ipso facto* type of the genus. (Type by absolute tautonomy.)

"II. Cases in which the generic type is not accepted *solely* upon the basis of the original publication.

"(*e*) The following species are excluded from consideration in selecting the types of genera:

"(*a*) Species which are not included under the generic name at the time of its original publication.

"(*β*) Species which were *species inquirendæ* from the standpoint of the author of the generic name at the time of its publication.

(*γ*) Species which the author of the genus doubtfully referred to it.

"(*f*) In case a generic name without originally designated type is proposed as a substitute for another generic name, with or without type, the type of either, when established, becomes *ipso facto* type of the other.

"(*g*) If an author, in publishing a genus with more than one valid species, fails to designate (see *a*) or to indicate (see *b, d*) its type, any subsequent author may select the type, and such designation is not subject to change. (Type by subsequent designation.)

"The meaning of the expression 'select a type' is to be rigidly construed. Mention of a species as an illustration or example of a genus does not constitute a selection of a type."

The type species of a genus is thus determined by one or the other of the following four methods: (1) 'Type by original designation,' or by the designation of the founder at the time of the original publication of the genus. (2) Monotypical genera,' in which the only species originally contained in the genus is necessarily the type. (3) 'Type by absolute tautonomy.' (4) 'Type by subsequent designation,' or by the action of a later author. The first three of these are 'hard and fast' rules, being absolutely without ambiguity. The rule based on tautonomy appears here for the first time as an authorized rule in any published code of rules, but it had previously received formal approval[1]; it was virtually included in the B. A. Code of 1842, and has had practical recognition ever since. The fourth rule is equally time-honored, having been the foundation of type determination for originally typeless genera for three fourths of a century. It is made by Article 30 subject to the conditions imposed by the rules which precede it.[2] It thus becomes also a hard and fast rule, although considerable research may be sometimes necessary to find where, when, and by whom the type of a genus was established by subsequent designation.

The expression in rule *g.*, "any subsequent author may select the type, and such designation is not subject to change," is obviously to be taken in its common sense relation to the rules that precede it, and not in the abstract sense that such action must be final, right or wrong. As this latter construction is liable to be taken by inexperienced nomenclators, an explicit definition might well have been added by the Commission, as was done in the case of the expression "select a type," stating what species are not available as types by subsequent designation.

Our present fabric of nomenclatural rules has been of slow growth. Without going into details, it may be noted that prior to 1842 there was no official code of nomenclature; each author was his own arbiter, not only as to the sources from which names might be taken and to whom they should be accredited, but in respect to the sense in which they should be employed. It was considered proper to refer names, both generic and specific, back to Moerhing, Ray, or Willughby, or even to Gesner, that date properly only from Linnæus or some later author, and to construe them in their ancient sense when this differed from the modern application of them. They felt at liberty to discard or to transfer to new associations names bestowed upon groups by their predecessors or contemporaries, and even their own names, in cases where they thought they could suggest more appropriate ones, or where they fancied they could apply them in a more fitting manner.

Nor did these practices altogether cease till long past the middle of the nineteenth century. It is now recognized that a genus is not satisfactorily established until its type has been definitely assigned. Yet the concept of a generic type, in the modern sense, had no existence till 1820 or later, and the conservation of a generic name in its original sense was not considered obligatory till a much later period. The idea that it was necessary to define a generic name by reference to it of a type species was of slow development, and did not obtain very general recognition till about 1825–1830, or later. The earlier systematists (Illiger, Vieillot, Lesson, Swainson, Vigors, Boie, Brehm, Kaup, etc.) thought it sufficient to cite one or more species — generally several — as examples of the genera they saw fit to recognize. From about 1824 on, a few writers when proposing new genera sometimes, but far from uniformly, specified some particular species as the type; and when revising the genera previously founded sometimes designated some one of its original species, or some other, as "type," but more frequently mentioned several species that might be considered collectively as "the types" or examples of the genus mentioned.

---

[1] A Method of Fixing the Type in Certain Genera. Science, N. S., XVI, No. 394, pp. 114, 115, July 18, 1902.

[2] "The designation of type species of genera shall be governed by the following rules (*a–g*), *applied in the following order of precedence.*"

G. R. Gray as a First Reviser.

The designation of types for all genera of birds was made for the first time by George Robert Gray in 1840, in his 'List of the Genera of Birds,' which thus became an epoch making work in avian nomenclature, especially in the matter of supplying types for the previously typeless genera. In this work he formally recognized "1065 genera and subgenera," and formally designated a type species for each. A second edition[1] appeared in 1841, and a supplement was added in 1842. In the 1841 edition the number of genera and subgenera was reduced to 1037, the number of names treated as synonyms being considerably increased, a total of 2026 names being entered in the index. In 1855 he brought out another edition, in which the number of genera and subgenera for which he designated types was increased to 2403, and the number of names in the index to 4606. Of the 2403 names recognized as valid, 765 were given the rank of genera, and 1638 were rated as subgenera.

---

[1] The several editions of Gray's 'List' are as follows:

A List | of the | Genera of Birds, | with | an indication of the Typical Species of each Genus.| Compiled from various sources. | By | George Robert Gray, | Ornithological Assistant, Zool. Departm., British Museum; | and | author of several works on Entomology, etc. | Printed by Richard and John E. Taylor, Red Lion Court, Fleet Street. | 1840.— 8vo, pp. viii + 80 + ii. No index, and genera not numbered. "1065 Genera and Subgenera, not including their synonyms," etc.— p. 80.

A List | of the | Genera of Birds, | with their Synonyma, | and | an indication of the Typical Species of each Genus. | By | George Robert Gray. | Second edition, | revised, augmented, and accompanied with an Index. | London: | Printed and sold by Richard and John E. Taylor, | Red Lion Court, Fleet Street. | 1841.— 8vo, pp. xii + 115. Index, but the genera are not numbered.

About 1037 genera are here recognized, 20 of them being unnamed. Reissued in 1842, with an Appendix of 16 pages.

Catalogue | of the | Genera and Subgenera | of Birds | contained in the | British Museum.| London: | Printed by order of the Trustees. | 1855.—12mo, 2ll. (= title-page and "Introduction," by John Edward Gray), pp. 192. With an index, and the genera and subgenera consecutively numbered.

2403 numbered genera and subgenera of existing birds, with, in an appendix (Appendix II) an additional list of the fossil genera, etc.

"The principal object of the present Catalogue is to give a complete List of the Genera and Subgenera of Birds, with their chief Synonyma and Types: much attention has been paid to the date of publication of each name.

"It commences with the 'Systema Naturæ,' published by Linnæus in 1735, and great labour has been bestowed in collecting them from the various works and periodicals, to the present period.

"The Genera are marked by an Asterisk, and those left unmarked are to be considered only of subgeneric value."— *Introduction.*

765 are marked as genera, leaving 1638 subgenera.

In 1840–1842 Gray's knowledge of the work of previous authors was confessedly incomplete, as he states in his preface that he had been unable to obtain access to some of the important systematic publications of continental ornithologists. A large number of the previously published genera of birds were consequently omitted from his 1840 'List'; most of them, however, were added in the subsequent editions. In the first edition he took Linnæan genera from their first date of publication (from 1735 and later, as the case might be), and ascribed many genera to Ray and other pre-Linnæan authors, adhering to their ancient signification when it differed from the modern acceptation. He wrongly ascribed many genera to Brisson, and discarded all names previously used in botany. He based his rulings on "the inflexible law of priority." In the 1855 edition he still took Linnæan genera from 1735–1766, and retained Moehring's names (1752), but abandoned other pre-Linnæan sources, and discarded many of the names he had previously wrongly taken from Brisson. Yet, notwithstanding all these sources of error, the greater part of his type designations were made in accordance with modern rules of nomenclature, which when the first three editions of his 'List of the Genera of Birds' were published had no official existence. These designations were for the most part accepted by his contemporaries and are now the currently accepted types of the genera in question. On the other hand, those designated erroneously have not been adopted by subsequent systematists and are not now and never have been the currently accepted types of the genera for which they were designated. A large number of these early errors were corrected by Gray himself in the later editions of his List, on the basis of subsequently acquired knowledge of the literature of ornithology, and of the relations of groups he at first wrongly relegated to synonymy, evidently in part due to Strickland's friendly criticism of the first edition.[1]

Gray's errors of type designation in the early editions of his 'List of Genera' are not faults to be severely criticized but are to be looked upon as an exposition of the orderless condition of nomenclature at the date of the formulation of the British Association 'Series of Propositions for rendering the Nomenclature of Zoology uniform and permanent.' He was even more consistent than most of his contemporaries in systematic ornithology, as Lesson, Bonaparte, Temminck, Swainson, and Vigors. Strickland, the acknowledged originator of the B. A. Code, had reached a higher plane, as shown in his 'Commentary' (*l. c.*) on Gray's 1840 'List.'

---

[1] Commentary on Mr. G. R. Gray's 'Genera of Birds.' 8vo, London, 1840. By H. E. Strickland. Ann. and Mag. Nat. Hist., VI, Jan. 1841, pp. 410–423; VII, May, 1841, pp. 26–41, 159.

Gray was not the first author to designate generic types, but he was the first to do this in a uniform manner for a whole class of animals. Vigors, in 1825 and later, nearly always designated types for his own new genera, and occasionally indicated types for genera previously proposed by others. Lesson, in 1828, explicitly designated types for about 150 genera and subgenera out of about 342 genera and 30 subgenera recognized by him in his 'Manual d'Ornithologie.' About 90 of the genera for which he designated types were monotypic, and 40 were polytypic, with about the same proportions for the subgenera. His type designations are generally the same as Gray's and of course long antedate them. Swainson (1827–1837) was quite as irregular and erratic, often assigning as types of genera species not originally contained in them, or indicating several species as 'typical' which are now treated as noncongeneric. In 1827 (Zool. Journ., III, 158–175, 343–363), he properly designated the types of 44 genera out of the 64 formally treated in his paper entitled 'On several Groups and Forms in Ornithology, not hitherto defined.' In 1837 (Class. Bds., Vol. II), he gave examples and not types, in the sense of type designation as defined by Article 30 of the International Code. Only where new genera are proposed, containing only a single species, can his examples be taken as types under Article 30. Bonaparte (1827–1854) was even more inconsistent, and paid little respect to any rules of nomenclature, habitually disregarding even the law of priority. Yet the work of all these authors, under the 'type by subsequent designation' rule, must be seriously considered, and when their generic type designations are in conformity with the rules of Article 30 of the International Code are to be accepted, but not otherwise. In other words, their work is not exempt from the conditions to which present day systematists are subjected.

Rule *g* of Article 30 states: "The meaning of the expression 'select a type' is to be rigidly construed. Mention of a species as an illustration or example of a genus does not constitute a selection of a type." When, however, an author has restricted an early polytypic genus, notably a Linnæan genus, to a single species by placing all the others in other genera, his action should be taken as tantamount to establishing a type for the original genus thus restricted, since such action has been commonly recognized by subsequent systematists as virtually fixing the type. In some instances, noted in the following pages, unless such restriction is recognized as a valid designation of a type complications ensue. Vieillot, in 1816 (Analyse), used 'esp.,' and not type, whether one or more species are cited. When only one is given that species has universally been accepted by later writers as the type, although the genus was evidently intended to include a number of species. The same practice prevails with respect to other authors when the conditions are similar. Thus Boie (Isis, 1826, 977) established a genus of woodpeckers in the following manner: "*Dryobates*: *Picus pubescens* Gm. u. s. w." Subsequent authors have not only recognized *Picus pubescens* Linn. as the type of *Dryobates*, but treat the genus as though it were monotypic when founded. In fact many so-called monotypic genera have had a similar origin.

As throwing light upon the way in which type designations were sometimes made by Gray in 1840, and changed by him later, the following illustrations (mostly North American genera) are given.

Alca Linn., 1758.— Gray in 1840 designated *A. impennis* Linn. as the type, a species which became type of the monotypic genus *Plautus* Brünn. 1772, the genus now, and for several decades past, in current use as the generic designation of *A. impennis*; but Gray failed to cite *Plautus* Brünn. in any of his works, and it may thus be supposed to have been unknown to him. The type of *Alca* has long been universally recognized as *A. torda* Linn., the genus *Torda* Duméril, 1806, being a strict synonym of *Plautus*, and having nothing to do with *Alca torda*, as the name itself might seem to imply. The subsequent designation in the same year of *Alca torda* as "z. B." of *Torda* by Froriep has no force, as the diagnosis of *Torda* Duméril shows clearly that it was monotypic with *Alca impennis* Linn. as type, as now currently recognized. (See Baird, Brewer and Ridgway, N. Am. Water Bds., II, 1884, 466; Olgivie-Grant, Brit. Mus. Cat. Birds, XXVI, 1898, 562.) *Torda* Froriep is thus preoccupied by *Torda* Duméril.

Thalasseus Boie, 1822.— In 1840, Gray gave the type as "*T. cantiaca* (Gm.) Boie," but failed to mention, in synonymy or otherwise, *Actochelidon* Kaup, 1829, a monotypic genus with *Sterna cantiaca* Gmel. as type. He, however, recognized *Sylochelidon* Brehm, 1830, a monotypic genus with *S. caspia* Pall. as the type. In 1855, he gave both *Thalasseus* and *Actochelidon*, the latter with *S. cantiaca* as type, changing the type of *Thalasseus* to *Sterna caspia*, and citing *Sylochelidon* Brehm as a synonym of *Thalasseus*. Thus in 1855 he duly corrected his errors of 1840 in respect to these three genera.

Anous Stephens, 1826.— In 1840, Gray wrongly credited *Anous* to Leach, but correctly made its type *Anous niger* Leach = *Sterna stolida* Linn. He wrongly synonymized with it *Hydrochelidon* Boie, 1822, and wrongly adopted *Megalopterus* Boie, 1826, as a genus distinct from *Anous*. This double error was soon after pointed out by Strickland (Ann. & Mag. Nat. Hist., VII, May, 1841, p. 40), who says: "Also note that *Anous*, Leach, is synonymous with *Megalopterus* Boié, and not with *Hydrochelidon*, Boié, and that *Anous niger*, Leach, is synonymous, not with *Sterna nigra*, Lin., but with *Megalopterus stolidus* (Lin.), Boié." (See also Boie, Isis, 1844, pp. 183, 187.) In 1841 Gray properly recognized *Hydrochelidon* Boie, with *Sterna nigra* Linn. as type, and "*Anous*, Leach, 1825 (in Steph.)" with *Sterna stolida* Linn. as type.

Fulmarus Stephens (ex Leach MS.), 1826.— In 1840, Gray made *Fulmarus* Leach a synonym of *Wagellus* Ray, with *Procellaria glacialis* Linn. as type. In 1841 he discarded *Wagellus*, making both it and *Fulmarus* synonyms of *Procellaria* Linn., changing, as below noted, the type of *Procellaria* to *P. glacialis*. In 1855 he restored *Fulmarus* to generic standing, with *P. glacialis* as the type, and gave "*Wagellus*, G. R. Gray, 1840" as one of its synonyms, but wrongly cited the authority for *Fulmarus* as "Leach, 1816."

Procellaria Linn.— Type as designated by Gray in 1840, *P. æquinoctialis* Linn. In 1841 he changed the type to *P. glacialis* Linn., a species not originally included in the genus, and therefore not available as its type. In 1855 he again changed the type of *Procellaria* to *P. pelagica* Linn., which species became in 1825 — thirty years before — type by original designation of the monotypic genus *Thalassidroma* Vigors. Gray thus, in 1855, made this genus a synonym of *Procellaria*, although in 1840 he had correctly listed both as full genera with their proper types.

Herodias Boie, 1822.— This genus consisted originally of two species, *Ardea egretta* Gmel. and *Ardea garzetta* Linn. *Ardea garzetta* became type of the monotypic genus *Egretta* Forster, 1817, and type by tautonomy of *Garzetta* Kaup, 1829. (*Garzetta* Kaup is a synonym of *Herodias* Boie, containing the same two species, and no others.) *Egretta* Forster was apparently unknown to Gray, as he nowhere cites it. In 1840, he wrongly took *Egretta* from Brisson and made *A. garzetta* Linn. its type, at the same time referring *Herodias* Boie to "*Egretta* Brisson," as a synonym. In 1841 he reversed this proceeding, accepting *Herodias* Boie, with *A. garzetta* as type, and synonymizing with it *Egretta* Brisson. As, however, *Egretta* Forster, 1817, was monotypic, with *Ardea garzetta* as type, this species could not be the type of *Herodias* Boie, 1822, as designated by Gray in 1841. As *Herodias* cannot be cancelled, its type must be its only other original species, *A. egretta* Gmel., as *correctly* designated by Gray in 1855.

Vultur Linn., 1758.— In 1840 Gray took *V. auricularis* Daud. 1800, as the type, a species not originally included in the genus. In 1841 he made this species the type of his new genus *Otogyps*. In 1841 he ascribed the genus *Vultur* to Mœrhing, 1752, and designated *V. cinereus* Gmel. as the type — also a species not originally included in the genus. In 1855 he gave the type of "*Vultur* Mœhr, 1752, et p. Linn. 1756" as *Vultur monachus*, still also a species not originally included in the genus *Vultur*, which properly dates only from Linnæus, 1758. Yet this species has been the currently accepted type from its designation as such by Gray in 1855 till the end of the year 1906, when the present writer determined the type, by elimination, as *Vultur gryphus* (Science, N. S., XXIV, No. 624, 54, Dec. 14, 1906), which, under Article 30 of the International Code should be accepted as the type, this being the first designation of a type from among the originally included species.

Cathartes Illiger, 1811, **Catharista** Vieillot, 1816, and **Sarcorhamphus** Duméril, 1806.— In 1840, Gray recognized *Cathartes*, with *Vultur aura* Linn. as type, and made *Catharista* a synonym of *Cathartes*. He also recognized *Sarcorhamphus* with *V. gryphus* Linn. as type. In 1855 he recognized *Sarcorhamphus* as before, but gave also recognition to *Catharista*, with *V. aura* as type, and synonymized *Cathartes* partly with *Sarcorhamphus* and partly with *Catharista*, a much later genus! The type of *Cathartes* was fixed 'by subsequent designation,' by Vigors in 1825 as *V. aura*, so that *V. aura* was not available in 1855 as type of *Catharista*. The type of *Sarcorhamphus* was fixed by subsequent designation by Vigors in 1825 as *Vultur papa* Linn., rendering invalid Gray's designation in 1840 of *V. gryphus* as type.

Trochilus Linn., 1758.— In 1840, Gray designated *T. polytmus* Linn. as the type, but in 1855 changed the type to *T. colubris* Linn., which has been the universally recognized type ever since. There is nothing in Article 30 of the International Code, nor in any other authoritative code of nomenclature, in conflict with Gray's action in 1840 in making *T. polytmus* the type of *Trochilus*, as this species did not become the type, nor congeneric with the type, of any other genus till 1860, when it became type of the monotypic genus *Aithurus* Cab. & Heine. In 1854 (Rev. de Zool., 2ᵉ sér., VI, May, 1854, 256), Bonaparte restricted *Trochilus* to the two congeneric species *T. colubris* Linn. and *T. alexandri* B. & M., and Gray in 1855 selected from these *T. colubris* as the type, which, as already said, has since been universally recognized as the type. Article 30 renders it necessary to accept *T. polytmus* as the type of *Trochilus*, and some other name is necessary for the group universally known for more than half a century as *Trochilus*.

Ampelis Linn., 1758.— In 1840, Gray designated *A. cotinga* Linn. as the type, and referred *Cotinga* Brisson, 1760, with the same species as type by tautonomy, to *Ampelis* as a synonym. He also recognized *Bombycilla* "Brisson" (= Vieillot, 1808), with *A. garrulus* Linn. as type. In 1841 he recognized *Cotinga* as a genus, with *A. cotinga* Linn. as the type, and changed the type of *Ampelis* to *A. garrulus* Linn., which has since been generally recognized as the type of *Ampelis*, he now synonymizing *Bombycilla* Vieill. with *Ampelis*. Vieillot, in 1808 (Ois. Am. Sept., I, "1807," 88, pl. lvii), founded his genus *Bombycilla* on the American Cedarbird, which had previously been referred by all writers to *A. garrulus* Linn. (*Lanius garrulus* Linn. 1758) as a variety. As the two species, *A. ampelis* Linn. and *B. cedrorum* Vieill., are strictly congeneric, *A. garrulus* became, in 1808, a member of Vieillot's genus *Bombycilla* and no longer belonged in *Ampelis*, a fact generally recognized by most European (continental) writers for the next fifty years, and by some of them still, while most English and American writers have continued to refer it to *Ampelis*, following Gray's second (1841) and *wrong* designation of the type. Under Article 30 of the International Code, or the rules of any other authoritative code, Gray had no right to cancel *Bombycilla* and virtually take its type as the type of *Ampelis*.

At 1808 only three of the original species of *Ampelis* were left in the genus, namely, *tersa*, *carnifex* and *pompadora*. As *pompadora* was the last one to be provided with a generic resting place, becoming the type of the monotypic genus *Xipholena* Gloger, 1842, this species necessarily becomes the correct type of *Ampelis*.

Helinaia Andubon, 1839.— Gray, in 1841, designated as type "*H. vermivora* (Lath.) Aud." = *Motacilla vermivora* Gmel., a species which became type of the monotypic genus *Helmitheros* Rafinesque in 1819, and was thus unavailable as the type of *Helinaia* in 1841.

II. LIST OF THE GENERA AND SUBGENERA OF NORTH AMERICAN BIRDS, WITH THEIR TYPES.

The present list includes not only all of the genera of the A. O. U. Check List, but many others which necessarily require consideration in this connection, numbering altogether about 550. The genera formally treated are arranged in four categories, in accordance with the manner in which their types have been determined. Each series is arranged alphabetically, but an index to all the genera mentioned is added at the end of the paper to facilitate reference to them.

The divisions of the list are based on Article 30 of the International Code and comprise two primary divisions based on whether or not the type is determined solely upon the original basis of the genus. The first primary division includes three subdivisions, in accordance with whether the type rests on original designation, on monotypy, or on tautonomy. The fourth category consists of genera with the type determined by subsequent designation.

In the case of the first three categories, it is difficult to draw a hard and fast line of separation, inasmuch as the types of some of the monotypic genera were also designated by the founder, and are also sometimes determinable by tautonomy. It has been thought best, therefore, to place in the list headed 'Type by Original Designation' only polytypic genera whose types depend upon the action of the founder at the time the genus was originally published. All monotypic genera are listed under the heading 'Monotypic Genera,' although some of them are tautonymic, and others, besides being monotypic, had their types originally designated by the founder. Under the heading 'Type by Tautonomy' are placed only polytypic genera the types of which depend upon tautonomy.

The original constitution of each genus has been given in a former paper (this 'Bulletin,' Vol. XXIII, April, 1907, pp. 287–379), and also the conditions under which the species here given as types came to be the types. It is considered unnecessary to repeat this information here.

1. TYPE DETERMINED SOLELY UPON THE BASIS OF THE ORIGINAL PUBLICATION OF THE GENUS.

a. Polytypic Genera with Type by Original Designation.

This list includes only polytypic genera which depend for type determination wholly upon the action of the founder at the time of the original publication of the genus. All monotypic genera are included in list *b*, whether or not they depend wholly upon monotypy for their types or have them also designated by the founder or determinable by tautonomy.

Amphispiza Coues, 1874. Type, *Emberiza bilineata* Cass.

Burrica Ridgway, 1887. Type, *Fringilla mexicana* Müller.

Callichelidon Baird, 1865. Type, *Hirundo cyaneoviridis* Bryant.

Canachites Stejneger, 1885. Type, *Tetrao canadensis* Linn. To replace *Canace* Reich. 1852, preoccupied.

Centrocercus Swainson, 1831. Type, *Tetrao urophasianus* Linn.

Ceophlœus Cabanis, 1862. Type, *Picus lineatus* Linn. Extralimital.

Chamæthlypis Ridgway, 1887. Type, *Geothlypis poliocephala* Baird.

Cryptoglaux Richmond, 1901. Type, *Strix tengmalmi* Gmel. To replace *Nyctala* Brehm, 1828, preoccupied.

Cyanocitta Strickland, 1845. Type, *Corvus cristatus* Linn.

Cymochorea Coues, 1864. Type, *Procellaria leucorrhoa* Vieill.

Daption Stephens, 1826. Type, *Procellaria capensis* Linn.

Dendragapus Elliot, 1864. Type, *Tetrao obscurus* Say. In reality monotypic, the several forms regarded as species in 1864 being now treated as subspecies of *T. obscurus*.

Endomychura Oberholser, 1899. Type, *Brachyrhamphus hypoleucus* Xantus. To replace *Micruria* Ogilvie-Grant, 1898, preoccupied.

Fregetta Bonaparte, 1855. Type, *Thalassidroma leucogastra* Gould = *Procellaria grallaria* Vieill.

Glaucionetta Stejneger, 1885. Type, *Anas clangula* Linn. = *Clangula* Leach, 1819, or Oken, 1817.

Hydranassa Baird, 1858. Type, *Ardea ludoviciana* Wils.

Hylocichla Baird, 1864. Type, *Turdus mustelinus* Gmel.

Iridoprogne Coues, 1878. Type, *Hirundo bicolor* Vieill.

Lanivireo Baird, 1866. Type, *Vireo flavifrons* Vieill.

Melospiza Baird, 1858. Type, *Fringilla melodia* Wils.

Muscivora G. Fischer, 1813 (ex Lacépède, 1799). Type, *Muscicapa forficata* Gmel.

Myioborus Baird, 1865. Type, *Setophaga verticalis* Swains.

Myiozetetes Sclater, 1859 (ex Bonaparte, 1854, *nomen nudum*). Type, "*Elainia cayennensis* auct." = *Muscicapa cayenensis* Linn.

Platypsaris Sclater, 1857 (ex Bonaparte, 1854, *nomen nudum*). Type, *Pachyrhamphus latirostris* Bonap.

Sphyrapicus Baird, 1858. Type, *Picus varius* Linn.

b. Monotypic Genera.

In many cases the type is also indicated 'by original designation,' and in a few cases also by tautonomy. In each case only a single species was included when the genus was originally founded. In some instances the type was virtually indicated by the founder without a distinct statement to that effect. It is thus often difficult to decide whether a genus should be placed here or in the preceding list, unless the separation is made on the basis of whether the genera are polytypic or monotypic.

Actochelidon Kaup, 1829. Type, *Sterna cantiaca* Gmel.

Actodromas Kaup, 1829. Type, *Tringa minuta* Leisler.

Æchmophorus Coues, 1862. Type, *Podiceps occidentalis* Lawr. Also by original designation.

Aëronautes Hartert, 1892. Type, *Cypselus melanoleucus* Baird.

Æthia Dumont, 1816. Type, *Alca cristatella* Pall. Antedates *Simorhynchus* Merrem, 1819, with same type by subsequent designation.

Ajaia Reichenbach, 1852. Type, *Platalea ajaja* Linn. Also tautonymic.

Alcella Stone, 1907. Type, *Alca pygmæa* Gmel. Also by original designation. Replaces *Phaleris* of the A. O. U. Check-List.

Alle Link, 1806. Type, *Alca alle* Linn. Also tautonymic. [Not seen.]

Anhinga Brisson, 1760. Type, [*Anhinga*] *anhinga* Briss. = *Plotus anhinga* Linn. Also tautonymic. Antedates *Plotus* Linn.

Aphriza Audubon, 1839. Type, *A. townsendi* Aud. = *Tringa virgata* Gmel.

Aramus Vieillot, 1816. Type, *Ardea scolopacea* Linn.

Archibuteo Brehm, 1828. Type, *Falco lagopus* Linn.

Arctonetta Gray, 1855. Type, *Fuligula fischeri* Brandt. To replace *Lampronetta* Brandt.

Arenaria Brisson, 1760. Type, [*Arenaria*] *arenaria* Briss. = *Tringa interpres* Linn. Also tautonymic.

Aristonetta Baird, 1858. Type, *Anas vallisneria* Wilson. Also by original designation.

Arquatella Baird, 1858. *Tringa maritima* Brünn.

Arremonops Ridgway, 1896. Type, *Emberiza rufivirgata* Lawr. Also by original designation.

Asarcia Sharpe, 1896. Type, *Parra variabilis* Linn. 1766 = *Fulica spinosa* Linn. 1758.

Asturina Vieillot, 1816. Type, *A. cinerea* Vieill. = *Falco nitidus* Gmel.

Asyndesmus Coues, 1866. Type, *Picus torquatus* Wils. Also by original designation.

Auriparus Baird, 1864. Type, *Ægithalus flaviceps* Sund. Also by original designation.

Bæolophus Cabanis, 1850. Type, *Parus bicolor* Linn.

Bartramia Lesson, 1831. Type, *B. laticauda* Less. = *Tringa bartramia* Wils. = *T. longicauda* Bechst. Also tautonymic.

Basileuterus Cabanis, 1848. Type, *Sylvia vermivora* Vieill.

Bombycilla Vieillot, 1807. Type, *B. cedrorum* Vieill. Replaces *Ampelis* Linn. of the A. O. U. Check-List.

Brewsteria Maynard, 1896. Type, *Falco ferrugineus* Licht. Also by original designation.

Budytes Cuvier, 1817. Type, *Motacilla flava* Linn.

Bulweria Bonaparte, 1842. Type, *Procellaria bulweri* Jard. & Selby. Also by virtual tautonomy.

Buteola Bonaparte, 1855. Type, *Buteo brachyurus* Vieill.

Butorides Blyth, 1849. Type, *Ardea javanica* Horsf.

Calamospiza Bonaparte, 1838. Type, *Fringilla bicolor* Towns. (preoccupied) = *Calamospiza melanocorys* Stejn.

Calcarius Bechstein, 1802. Type, *Fringilla lapponica* Linn.

Calidris Illiger, 1811. Type, *Charadrius calidris* Linn. = *Tringa arenaria* Linn. Also tautonymic.

Callipepla Wagler, 1832. Type, *C. strenua* Wagl. = *Ortyx squamatus* Vig.

Calothorax Gray, 1840. Type, *Ornismya cyanopogon* Less. = *Trochilus lucifer* Swains. Also by original designation.

Campephilus Gray, 1840. Type, *Picus principalis* Linn. Also by original designation.

Camptostoma Sclater, 1857. Type, *C. imberbe* Scl. Also by original designation. Replaces *Ornithion* of the Check-List, which is extralimital. (*Cf.* Ridgway, Bds. North and Mid. Amer., IV, 1907, 441 *et seq.*)

Cardellina Du Bus, 1850, Type, *C. amicta* Du Bus = *Muscicapa rubrifrons* Giraud. (Not seen.)

Casarca Bonaparte, 1838. Type, *Anas rutila* Pallas.

Catherpes Baird, 1858. Type, *Thryothorus mexicanus* Swains. Also by original designation.

Catoptrophorus Bonaparte, 1827. Type *Scolopax semipalmatus* Gmel.

Centronyx Baird, 1858. Type, *Emberiza bairdii* Aud.

Centurus Swainson, 1837. Type, *C. carolinensis* Wils. = *Picus carolinus* Linn. Also by original designation.

Cepphus Pallas, 1769. Type, *C. lacteolus* Pall. = *Alca grylle* Linn.

Cerchneis Boie, 1822. Type, *Falco rupicola* Licht.

Cerorhinca Bonaparte, 1828. Type, *C. occidentalis* Bonap. = *Alca monocerata* Pall.

Chamæa Gambel, 1847. Type, *Parus fasciatus* Gamb.

Charitonetta Stejneger, 1885. Type, *Anas albeola* Linn. Also by original designation.

Chaulelasmus Bonaparte (ex Gray, MS.), 1838. Type, *Anas strepera* Linn.

Chelidonaria Reichenow, 1889. Type, *Hirundo urbica* Linn. Also by original designation.

Chen Boie, 1822. Type, *Anser hyperboreus* Pall.

Chondestes Swainson, 1827. Type, *Chondestes strigatus* Swains.

Chordeiles Swainson, 1831. Type, *Caprimulgus virginianus* Gmel. Also by original designation.

Ciceronia Reichenbach, 1852. Type, *Phaleris nodirostris* Bonap. = *Uria pusilla* Pall.

Cinclus Borkhausen, 1797. Type, *Turdus cinclus* Linn.

Coccyzus Vieillot, 1816. Type, *Cuculus americanus* Linn.

Cœreba Vieillot, 1807. Type, *Certhiola flaveola* Linn.

Colinus Goldfuss, 1820. Type, *Tetrao virginianus* Linn.

Compsohalieus Ridgway, 1884. Type, *Carbo penicillatus* Brandt. Also by original designation.

Conuropsis Salvadori, 1891. Type, *Psittacus carolinensis* Linn. Also by original designation. Replaces *Conurus* Kuhl of the Check-List.

Coturnicops Bonaparte, 1856. Type, *Fulica noveboracensis* Gmel.

Creagrus Bonaparte, 1854. Type, *Larus furcatus* Neboux. Also by original designation.

Creciscus Cabanis, 1856. Type, *Rallus jamaicensis* Gmel. Also by original designation.

Crex Bechstein, 1802. *Rallus crex* Linn. Also tautonymic.

Crotophaga Linnæus, 1758. Type, *C. ani* Linn.

Cyanocephalus Bonaparte, 1842. Type, *Gymnorhinus cyanocephalus* Wied. Also tautonymic.

Cyanolæma Stone, 1907. Type, *Ornismya clemenciæ* Lesson. Also by original designation. Replaces *Cœligena* Lesson of the Check-List, extralimital.

Cyanosylvia Brehm, 1828. Type, *Motacilla suecica* Linn. = *Cyanecula* Brehm, on a later page in the same paper, with type by tautonomy, *Sylvia cyanecula* Wolf, congeneric with *M. suecica* Linn. Replaces *Cyanecula* of the Check-List.

Cyrtopelicanus Reichenbach, 1852. Type, *Pelecanus trachyryhnchus* Lath. = *P. erythrorhynchus* Gmel.

Dafila Stephens 1824. Type, *Dafila caudacuta* Steph. = *Anas acuta* Linn. Also by original designation.

Dendroica Gray, 1842. Type *Sylvia coronata* Lath. Also by original designation.

Dichromanassa Ridgway, 1878. Type, *Ardea rufa* Bodd. Also by original designation.

Dolichonyx Swainson, June, 1827. Type, *Emberiza oryzivora* Wils. = *Fringilla oryzivora* Linn. Also by designation of the founder in November, 1827.

Dumatella S. D. W[ood][1], 1837. Type, *D. felivox* = *Turdus felivox*

---

[1] "S. D. W." is the author also of a number of other names, both generic and specific, including *Densirostra atricapilla*, proposed to replace *Pyrrhula vulgaris*, which is the only one of them I have seen cited in synonymy. This case was criticised by Hugh E. Strickland in Loudon's Mag. Nat. Hist., VIII Jan. 1835, p. 39, as follows:

"Can S. D. W., for instance, expect that the whole republic of science will take the trouble of relabeling their cabinets, altering their catalogues, or making notes in their works of reference, because an anonymous writer fancies that he can improve *Pyrrhula vulgaris* by changing it to *Densirostra atricapilla*?"

Vieillot = *Muscicapa carolinensis* Linn. *Dumatella* antedates *Galeoscoptes* Cabanis, Oct. (?) 1850, with same type by subsequent designation (Baird, Rev. Am. Bds., 1864, 54), and *Spodesilaura* Reichenbach, March, 1850, monotypic, based on the same species. (For further comment on *Dumatella* see Stone, Auk, XXIV, April, 1907, 193.)

Dryobates Boie, 1826. Type, *Picus pubescens* Linn.

Dytes Kaup, 1829. Type, *Colymbus auritus* Linn.

Egretta Forster, 1817. Type, *Ardea garzetta* Linn.

Elanoides Vieillot, 1818. Type *Falco forficatus* Linn.

Elanus Savigny, 1809. Type *E. cæsius* Savig. = *Falco melanopterus* Daudin.

Empidonax Cabanis, 1855. Type, *Tyrannula pusilla* Swains.

Ereunetes Illiger, 1811. Type, *E petrificatus* Ill. = *Tringa pusilla* Linn. Antedates *Symphemia* Rafinesque, 1819, monotypic, with same type.

Ergaticus Baird, 1865. Type, *Setophaga rubra* Swains. Also by original designation.

Erionetta Coues, 1884. Type, *Anas spectabilis* Linn. Also by original designation.

Erismatura Bonaparte, 1832. Type, *Anas jamaicensis* Gmel. To replace *Oxyurus* Swainson, 1827, preoccupied.

Erolia Vieillot, 1816. Type, *Erolia variegata* Vieill. = *Tringa ferruginea* Brünn. Antedates *Ancylocheilus* Kaup, 1829, monotypic, with same type.

Eudromias Brehm, 1831. Type, *Charadrius morinellus* Linn.

Euetheia Reichenbach, 1850. Type, *Fringilla lepida* Linn.

Eugenes Gould, 1856. Type, *Trochilus fulgens* Swains.

Euphagus Cassin, 1866. Type, *Psarocolius cyanocephalus* Wagler = *Scolecophagus* Swainson, 1832 (preoccupied), monotypic, with same type by original designation.

Eurynorhynchus Nilsson, 1824. Type, *E. griseus* Nilsson = *Platalea pygmæa* Linn.

Exanthemops Elliot, 1868. Type, *Anser rossii* Cass.

Florida Baird, 1858. Type *Ardea cærulea* Linn.

Fratercula Brisson, 1760. Type, [*Fratercula*] *fratercula* Briss. = *Alca arctica* Linn. Also tautonymic.

Fregata Lacépède, 1799. Type, le Frégate = *Pelecanus aquilus* Linn.

" *Densirostra* Wood " is cited by Gray in his ' List of Genera of Birds,' first as a synonym of *Strobilophaga* Vieillot, 1816 (1840–41), and later (1855) as a synonym of *Pinicola* Vieillot, 1807. Waterhouse gives: " *Densirostra* Wood, The Analyst, a Journ. Sci. Lit. Nat. Hist., III, pp. 32, 204 (1835)." This seems to satisfactorily identify "S. D. W." as S. D. Wood, who was for some years not only a frequent contributor to ' The Analyst ' but to ' Loudon's Magazine of Natural History,' a dozen or more notes, short articles and book reviews, signed S. D. W., being contained in Vol. VIII, 1835.

Gelochelidon Brehm, 1830. Type, *G. balthica* Brehm. = *Sterna nilotica* Hasselq.

Geococcyx Wagler, 1831. Type, *G. variegata* Wagl. = *Saurothera californiana* Less.

Guara Reichenbach, 1852. Type, *Scolopax ruber* Linn.

Gymnogyps Lesson, 1842. Type, *Vultur californianus* Shaw. (Not seen.)

Hæmatopus Linnæus, 1758. Type, *H. ostralegus* Linn.

Haliæetus Savigny, 1809. Type, *H. nisus* Savign. = *Falco albicilla* Linn.

Halocyptena Coues, 1864. Type, *H. microsoma* Coues. Also by original designation.

Harelda Stephens, 1824. Type, *H. glacialis* = *Anas hyemalis* + *glacialis* Linn.

Harporhynchus Cabanis, 1847. To replace the monotypic genus *Harpes* Gambel, 1845 (preoccupied), with *Harpes rediviva* Gambel as type.

Helmitheros Rafinesque, 1819. Type, *H. migratorius* Raf. = *Sylvia vermivora* Wils. = *Motacilla vermivora* Gmel. Also type by "virtual tautonomy." Antedates *Vermivora* Swains. 1827, with same type by tautonomy and by designation of the founder.

Helodromas Kaup, 1829. Type, *Tringa ochropus* Linn.

Hesperiphona Bonaparte, 1850. Type, *Fringilla vespertina* Cooper. Also by original designation.

Heteractitis Stejneger, 1884. Type, *Scolopax incanus* Gmel. To replace *Heteroscelus* Baird, 1858, monotypic, with same type, preoccupied.

Hierofalco Cuvier, 1817. Type, *Falco candicans* Gmel. = *F. islandus* Brünn.

Histrionicus Lesson, 1828. Type, *Anas histrionicus* Linn. Also by both original designation and tautonomy.

Icteria Vieillot, 1807. Type, *Icteria dumicola* Vieill. = *Turdus virens* Linn.

Ictinia Vieillot, 1816. Type, *Falco plumbeus* Gmel.

Ionornis Reichenbach, 1850. Type, *Fulica martinica* Linn.

Ixoreus Bonaparte, 1854. Type, *Turdus nævius* Gmel. Also by original designation.

Jabiru Hellmayr, 1906. Type, *Ciconia mycteria* Lichtenstein (1819) = *Mycteria americana* auct. *nec* Linn. Also by original designation. (*Cf.* Hellmayr, Abhandl. der K. B. Akad. Wissen., II Kl., XXII Bd., 3 Abt., p. 711, May 20, 1906.) Replaces *Mycteria* of the Check-List and of authors generally.

Junco Wagler, 1831. Type, *Junco phæonotus* Wagler = *Fringilla cinerea* Swains. (preoccupied).

Kamptorhynchus Eyton, 1838. Type, *Anas labradoria* Gmel. = *Camptolaimus* Gray, 1841, of the Check-List.

Leptopelicanus Reichenbach, 1852. Type, *Pelecanus fuscus* Gmel. = *P. onocrotalus β occidentalis* Linn.

Leptotila Swainson, 1837. Type, *P.* [*eristera*] *rufaxilla* Selby.

Leucosticte Swainson, 1832. Type, *Linaria* (*Leucosticte*) *tephrocotis* Swains. Also by original designation.

Lobipes Cuvier, 1817. Type, *Tringa lobata* Linn.

Lophodytes Reichenbach, 1852. Type, *Mergus cucullatus* Linn.

Machetes Cuvier, 1817. Type, *Tringa pugnax* Linn. Antedates *Pavoncella* Forster, 1817, with same type by inference only.

Macronectes Richmond, 1905. Type, *Procellaria gigantea* Gmel. To replace *Ossifraga* H. & J., 1844, preoccupied, with same type.

Macrorhamphus Forster, 1817. Type, *Scolopax griseus* Gmel.

Megalestris Bonaparte, 1856. Type, *M. catarrhactes* Bonn. = *Catharacta skua* Brünn.

Melanerpes Swainson, 1831. Type, *Picus erythrocephalus* Linn. Also by original designation.

Mergellus Selby, 1840. Type, *Mergus albellus* Linn. (Not seen.)

Micropalama Baird, 1858. Type, *Tringa himantopus* Bonap. Also by original designation.

Micropallas Coues, 1889. Type, *Athene whitneyi* Cooper. To replace *Micrathene* Coues, 1886, preoccupied, with same type by original designation.

Mimus Boie, 1826. Type, *Turdus polyglottos* Linn. Antedates *Orpheus* Swains., 1828, and *Mimetes* Gloger, 1842, each with same type.

Mniotilta Vieillot, 1816. Type, *Motacilla varia* Linn.

Molothrus Swainson, 1831. Type, *Fringilla pecoris* Gmel. = *Oriolus ater* Bodd. Also by original designation.

Myadestes Swainson, 1838. Type, *Myadestes genibarbis* Swains.

Mycteria Linnæus, 1758. Type, *M. americana* Linn. = *Tantalus loculator* Linn., posterior in precedence on the same page. Hence *Tantalus* is a synonym of *Mycteria*, both being founded on the same species.

The generic diagnosis of *Mycteria* was evidently taken from Marcgrave's figure and description of the Jabiru, but that of the species was based on Marcgrave's Jabiru-guacu = Catesby's Wood Pelican (*Pelecanus sylvestris* on the plate), which is the sole basis of Linnæus's *Tantalus loculator*. The amended Article 30 of the International Code of Nomenclature provides: "A genus proposed with a single original species takes that species as its type." The same provision is also included in the Revised A. O. U. Code (as yet unpublished). This renders it necessary to treat *Tantalus* as a synonym of *Mycteria,* which precedes *Tantalus* on the same page.[1]

Myiochanes Cabanis, 1859. Type, *Tyrannula curtipes* Swains. = *Platyrhynchus cinereus* Spix. apud Sclater, P. Z. S., 1859, 43, footnote. To replace *Syrichtha* Bonap., 1854 (preoccupied), with same type. = *Contopus* Cabanis, 1855 (preoccupied), type *Muscicapa virens* Linn., a species congeneric with *P. cinereus* Spix. = *Horizopus* Oberholser, 1899, to replace *Contopus* (preoccupied), with same type. (*Cf.* Ridgway, Bds. North and Mid. Amer., IV, 1907, 509.)

Nannus Bilberg, 1828. Proposed as a substitute for *Troglodites* Cuvier, 1817, monotypic and tautonymic, with *Motacilla troglodytes* Linn. as type. Antedates *Olbiorchilus* Oberholser, 1902, with same type. (On *Nannus* Bilberg, see Stone, Auk, April 1907, 194.)

Neocorys Sclater, 1857. Type, *Alauda spragueii* Aud. Also by original designation.

Netta Kaup, 1829. Type, *Anas rufina* Pall.

Nettion Kaup, 1829. Type, *Anas crecca* Linn.

Nomonyx Ridgway, 1880. Type, *Anas dominica* Linn. Also by original designation.

Nucifraga Brisson, 1760. Type, [*Nucifraga*] *nucifraga* Briss. = *Corvus caryocatactes* Linn. Also tautonymic.

Nuttallornis Ridgway, 1887. Type, *Tyrannus borealis* Swains. Also by original designation.

Nyctanassa Stejneger, 1887. Type, *Ardea violacea* Linn. Also by original designation.

Nyctidromus Gould, 1838. Type, *N. derbyanus* Gould = *Caprimulgus albicollis* Gmel.

Oceanites Keyserling & Blasius, 1840. Type, *O. wilsoni* Bonap. = *Procellaria oceanica* Kuhl. Also 'by virtual tautonomy.'

Oceanodroma Reichenbach, 1852. *Procellaria furcata* Gmel.

Ochthodromus Reichenbach, 1852. Type, *Charadrius wilsonius* Ord.

Onychoprion Wagler, 1832. Type *Sterna serrata* Wagler = *S. fuliginosa* Gmel. = *Haliplana* Wagler, 1832 (on a later page of the same volume), monotypic, with same type.

Oreortyx Baird, 1858. Type, *Ortyx pictus* Dougl. Also by original designation.

Oreospiza Ridgway, 1896. Type, *Fringilla chlorura* Aud. Also by original designation.

---

[1] By these changes *Mycteria americana* of the Check-List and of authors generally becomes *Jabiru mycteria* (Licht.) Hellmayr, and *Tantalus loculator* Linn. becomes *Mycteria americana* Linn. For a statement of the case in detail see Auk, XXV, Jan. 1908, p—.

Ornithion Hartlaub, 1853. Type, *Ornithion inerme* Hartl. Extralimital. Replaced by *Camptostoma* Sclater, 1857.

Oroscoptes Baird, 1858. Type, *Orpheus montanus* Towns.

Otocoris Bonaparte, 1838. Type, *Alauda chrysolæma* Wagler, a subspecies of *Alauda alpestris* Linn.

Otus Pennant, 1769. Type, *O. bakkamœna* Penn. Antedates *Scops* Savigny, 1809, and *Megascops* Kaup, 1829, both with *Strix asio* Linn., a congeneric species, as type.

Oxyechus Reichenbach, 1852. Type, *Charadrius vociferus* Linn.

Pachysylvia Bonaparte, 1850. Type, *Sylvicola decurtata* Bonap. = *Hylophilus* Temminck, 1823 (preoccupied), with type *H. thoracicus* by subsequent designation.

Pagophila Kaup, 1829. Type, *Larus eburneus* Phipps = *L. albus* Gunn. = *Gavia* Boie, 1822, nec *Gavia* Forster, 1788, nec *Gavia* Goldfuss, 1820.

Pallasicarbo Coues, 1899. Type, *Phalacrocorax perspicillatus* Pallas. Also by original designation.

Pandion Savigny, 1809. Type, *Falco haliaëtus* Linn.

Parabuteo Ridgway, 1874. Type, *Falco unicinctus* Temm. To replace *Antenor* Ridgway, 1873, with same type by original designation.

Passerella Swainson, 1837. Type, *Fringilla iliaca* Merrem.

Pediœcetes Baird, 1858. Type, *Tetrao phasianellus* Linn. Also by original designation.

Pelagodroma Reichenbach, 1852. Type, *Procellaria marina* "Forst." (= Lath.).

Pelionetta Kaup, 1829. Type, *Anas perspicillata* Linn.

Penthestes Reichenbach, 1850. Type, *Parus lugubris* Temm.

Peucedramus Coues, 1876. Type, *Sylvia olivacea* Giraud. Also by original designation.

Phainopepla Sclater, 1858. Type, *Ptilogonys nitens* Swains. Also by original designation.

Phalænoptilus Ridgway, 1880. Type, *Caprimulgus nuttalli* Aud. Also by original designation.

Philacte Bannister, 1870. Type, *Anas canagica* Sevast.

Philohela Gray, 1841. Type, *Scolopax minor* Gmel. Also by original designation.

Phlœotomus Cabanis, 1863. Type, *Picus pileatus* Linn. To replace *Hylatomus* Baird, 1858, preoccupied.

Phœbastria Reichenbach, 1852. Type, *Diomedea brachyura* Temm. = *D. albatrus* Pall.

Phœbetria Reichenbach, 1852. Type, *Diomedea fuliginosa* Gmel.

Phœnicopterus Linnæus, 1758. Type, *P. ruber* Linn.

Picicorvus Bonaparte, 1850. Type, *Corvus columbianus* Wils.

Pinicola Vieillot, 1807. Type, *Pinicola rubra* Vieill. = *Loxia enucleator* Linn.

Pipilo Vieillot, 1816.[1] Type, *Fringilla erythrophthalma* Linn.

Piranga Vieillot, 1807. Type, *Piranga rubra* Vieill. = *Fringilla rubra* Linn.

Pitangus Swainson, 1827. Type, *Lanius sulphuratus* Linn.

Plautus Brünnich, 1772. Type, *Alca impennis* Linn. Antedates *Torda* Dumeril, 1806, with same type.

Plectrophenax Stejneger, 1882. Type, *Emberiza nivalis* Linn. Also by original designation.

Plegadis Kaup, 1829. Type, *Tringa autumnalis* Hasselq.

Podasocys Coues, 1866. Type, *Charadrius montanus* Towns. Also by original designation.

Podilymbus Lesson, 1831. Type, *Colymbus podiceps* Linn.

Polyborus Vieillot, 1816. Type, *Falco tharus* Mol.

Polysticta Eyton, 1836. Type, *Anas stelleri* Pall. = *Stelleria* Bonaparte, 1838, = *Eniconetta* Gray, 1840, both with same type.

Poœcetes Baird, 1858. Type, *Fringilla graminea* Gmel.

Porzana Vieillot, 1816. Type, *Rallus porzana* Linn. Also tautonymic.

Priocella Hombron & Jacquinot, 1844. Type, *P. garnottii* H. & J. = *Procellaria glacialoides* Smith.

Progne Boie, 1826. Type, *Hirundo purpurea* Wils. = *Hirundo subis* Linn.

Protonotaria Baird, 1858. Type, *Motacilla protonotaria* Gmel. = *Motacilla citrea* Bodd. Also tautonymic.

Psaltriparus Bonaparte, 1850. Type, *Psaltriparus personatus* Bonap. = *Parus melanotis* Hartl.

Ptychoramphus Brandt, 1837. Type, *Uria aleutica* Pall.

Pyrrhuloxia Bonaparte, 1850. Type, *Cardinalis sinuatus* Bonap.

Recurvirostra Linnæus, 1758. Type, *R. avocetta* Linn.

Regulus Cuvier, 1799. Type, *Motacilla regulus* Linn. Also tautonymic.

Rhantistes Kaup, 1829. Type, *Procellaria glacialis* Linn. Replaces *Fulmarus* Stephens, 1826, *auct.*, of the Check-List, with same type by subsequent designation by Gray in 1855. Gray designated as type of *Fulmarus* a species already type of a monotypic genus.

---

[1] **Hortulanus** Vieillot, 1807. This genus contained originally three species, with no type indicated. Vieillot himself apparently never again made use of the name but later (1817) referred two of the species to his subsequent genus *Passerina* (1816), and made the other the type of his subsequent genus *Pipilo* (1816). No later author has cited the name except in synonymy, and it has consequently never had any standing, nor, of course, any type. All of the species originally referred to it later became the types of other genera. Under Article 30 of the International Code *Hortulanus* has no standing.

Rhodostethia Macgillivray, 1840. Type, *Larus rosea* Macgill. Also by original designation.

Rhynchofalco Ridgway, 1873. Type, *Falco femoralis* Temm. = *F. fusco-cærulescens* Vieill. Also by original designation.

Rhynchophanes Baird, 1858. Type, *Plectrophanes mccownii* Lawr.

Rhynchopsitta Bonaparte, 1854. Type, *Macrocercus pachyrhynchus* Swains.

Riparia Forster, 1817. Type, *Riparia europæa* Forst. = *Hirundo riparia* Linn. Also tautonymic. Antedates *Clivicola* Forster, 1817, and *Cotile* Boie, 1822, both with same type.

Rissa Stephens, 1825. Type, *R. brunnichii* Steph. = *Larus tridactylus* Linn. 1758 = *L. rissa* et *tridactyla* Linn. 1766; hence also tautonymic. Also type by original designation.

Rostrhamus Lesson, 1831. Type, *R. niger* Less. =*Herpetotheres sociabilis* Vieill.

Sayornis Bonaparte, 1854. Type, *Tyrrannula nigricans* Swains.; *T. saya* Swains., by designation of Gray in 1855, a species congeneric with *nigricans*.

Sitta Linnæus, 1758. Type, *S. europæus* Linn.

Somateria Leach, 1819. Type, *Anas mollissima* Linn.

Spatula Boie, 1822. Type, *Anas clypeata* Linn. = *Anas* Swainson (*nec* Linn.) 1831, with same type.

Speotyto Gloger, 1842. Type, *Strix cunicularia* Mol.

Spizella Bonaparte, 1832. Type, *Fringilla pusilla* Wilson.

Starnœnas Bonaparte, 1838. Type, *Columba cyanocephala* Linn.

Steganopus Vieillot, 1819. Type, *S. tricolor* Vieill.

Stelgidopteryx Baird. Type, *Hirundo serripennis* Aud. Also by original designation.

Stellula Gould, 1861. Type, *Callothorax calliope* Gould.

Sternula Boie, 1822. Type, *Sterna minuta* Linn.

Sturnella Vieillot, 1816. Type, *Alauda magna* Linn.

Surnia Duméril, 1806. Type, *Strix funerea* Linn.

Syrnium Savigny, 1809. Type, *S. ululans* = *Strix aluco* Linn. 1766 (nec *aluco* Linn. 1758).

Tachybaptus Reichenbach, 1849. Type, *Colymbus ruficollis* Pallas. = *Podiceps* Latham, 1787, untenable. (*Cf.* Bull. Amer. Mus. Nat. Hist., XXIII, 1907, 289.)

Tachytriorchis Kaup, 1844. Type, *Falco pterocles* Temm. = *Buteo albocaudatus* Vieill.

Tangavius Lesson, 1839. Type, *T. involucratus* Lesson = *Molothrus* [*æneus*] *robustus* Cab. Antedates *Callothrus* Cassin, 1866, monotypic, with *Psarocolius æneus* Wagler as type.

Tantalus Linnæus, 1758. Type, *Tantalus loculator* Linn. = *Mycteria americana* Linn. Hence = *Mycteria* Linn.

Thalassidroma Vigors, 1825. Type, *Procellaria pelagica* Linn. Also by original designation. Replaces *Procellaria* of the Check-List.

Thalassogeron Ridgway, 1884. Type *Diomedea culminata* Gould. = *Thalassarche* Reich., 1852, preoccupied. Also by original designation.

Thrassaëtos Gray, 1838. Type, *Vultur harpyia* Linn. To replace *Harpyia* Ill., 1816, preoccupied.

Thryomanes Sclater, 1862. Type, *Troglodytes bewickii* Aud.

Thryothorus Vieillot, 1816. Type, *Troglodytes arundinaceus* Vieill. (part) = *Sylvia ludoviciana* Lath. (*Cf.* Baird, Bds. N. Am., 1858, 359; Allen, Bull. Am. Mus. Nat. Hist., XXIII, 1907, 374.)

Toxostoma Wagler, 1831. Type, *T. vetula* Wagler = *Orpheus curvirostris* Swains.

Trogon Brisson, 1760. Type, *Trogon strigilatus* Linn. = *T. viridis* Linn. Of Brisson's 6 species 3 are not positively identifiable; the other 3 are referable to a single species, commonly known as *Trogon viridis* Linn. = *T. strigilatus* Linn. which has precedence of position on the same page over *viridis*.

Tryngites Cabanis, 1856. Type, *Tringa subruficollis* Vieill. Also by original designation.

Tympanuchus Gloger, 1842. Type, *T. cupido* Glog. = *Tetrao cupido* Linn.

Urubitinga Lafresnaye, 1843. Type, *Falco urubitinga* Gmel. Also tautonymic.

Xanthocephalus Bonaparte, 1850. Type, *X. perspicillatus* (Licht.) = *Icterus xanthocephalus* Bonap. Also tautonymic.

Xema Leach, 1819. Type, *Larus sabinii* Leach.

Xenopicus Baird, 1858. Type, *Leuconerpes albolarvatus* Cass.

Zamelodia Coues, 1880. To replace *Habia* Reich. (preoccupied), monotypic, with *Guiraca melanocephala* Swains. as type.

Zenaidura Bonaparte, 1854. Type, *Columba carolinensis* Linn.

c. *Polytypic Genera with Type dependent upon Tautonomy.*

The following list includes only those genera of which the type rests solely upon the condition of tautonomy. Many other genera are tautonymic, but are also monotypic, and for reasons already stated (p. 13) are placed in list *b*.

Accipiter Brisson, 1760. Type, [*Accipiter*] *accipiter* Briss. = *Falco nisus* Linn.

Amizilis Gray, 1840. Type, *Orthorhynchus amazili* Less.

Anser Brisson, 1760. Type, [*Anser*] *domesticus* Briss. ex Gesner = *Anas anser* Linn.

Aquila Brisson, 1760. Type, [*Aquila*] *aquila* Briss. = *Falco chrysaëtos* Linn.

Asio Brisson, 1760. Type, [*Asio*] *asio* Briss. = *Strix otus* Linn.

Bubo Duméril, 1806. Type, *Strix bubo* Linn.

Buteo Cuvier, 1799. Type, *Falco buteo* Linn.

Cardinalis Bonaparte, 1837. Type, *Cardinalis virginianus* Bonap. = *Loxia cardinalis* Linn.

Carduelis Brisson, 1760. Type, [*Carduelis*] *carduelis* Briss. = *Fringilla carduelis* Linn.

Clangula Leach, 1819 (ex Gesner), or Oken, 1817.[1] Type, *Anas*

---

[1] Oken in his 'Cuviers und Okens Zoologien neben einander gestellt' (Isis oder Encyclopädische Zeitung, VIII, 1817, Nos. 144–148, pp. 1143–1186), in transcribing Cuvier's names of groups, gave to some of Cuvier's vernacular names a Latin form, without citing the vernacular names or giving any indication of their relation to Cuvier's groups beyond the order of succession and the fact that his names happen to be for the most part tautonymic. If these names of Oken are to be recognized, as some contend (see Gill, Proc. U. S. Nat. Mus., XXVI, 1903, pp. 965–967; and Stone, Auk, XXIV, 1907, p. 191), they will replace several current names and carry back the authority and date of a few others to Oken, 1817. The names in ornithology thus affected are:

Cuvier's Names.	*Oken's Names.*	*Cuvier's Names.*	*Oken's Names.*
Sarcelles.	Querquedula.	Les Colins.	Colin.
Les Tadornes.	Tadorna.	Les Francolins.	Francolinus.
Les Souchets.	Souchet.	Les Houppifères.	Houppifere.
Les Millouins.	Marila.	Les Alectors.	Alector.
Les Eiders.	Eider.	Les Jacamerops de Lavaillant.	Jacamerops.
Les Garrots.	Clangula.	Les Hoérotaires.	Hoerataria.
Les Macreuses.	Macreuse.	Les Remis.	Remis.
Les Bernaches.	Bernicla.	La Moustache.	Moustache.
Les Fregattes.	Fregata.	Le Sirli.	Sirli.
Les Noddis.	Noddi.	Le Calandre.	Calandra.
Le Courlan ou Courili.	Courlan.	——	Podarg.
La Demoiselle de Numidie.	Numidica.	La Grive proprement dite.	Grive
Les Tridactyles.	Tridactylus.		

As shown by the above list, some of Oken's names are merely Cuvier's vernacular names used in the singular instead of in the plural number. Fortunately, as in the cases of Macreuse and Colin, they refer to groups having a number of species, and no type is indicated; in other cases, as Souchet, Houppifere, and Noddi, they are monotypic, and the type is thus determinable. In still others, there are earlier names for the groups here designated by Oken by merely French names. A number of Oken's names that appear in Latin form are synonyms of earlier names; but seven appear here for the first time, though current in systematic ornithology from later authors. These are:

Querquedula, type by tautonomy, *Anas querquedula* Linn. = *Querquedula* Stephens, 1824.

Tadorna, type by tautonomy, *Anas tadorna* Linn. = *Tadorna* (Leach MS.) Fleming, 1822.

Marila, type by tautonomy, *Anas marila* Linn. = *Marila* Bonaparte, 1856 (nec Reichenbach, 1852) = *Fuligula* Stephens, 1824; type by tautonomy, *Anas fuligula* Linn., a species congeneric with *Anas marila*.

Clangula, type by tautonomy, *Anas clangula* Linn. = *Clangula* Leach, 1819.

Francolinus, type by tautonomy, *Tetrao francolinus* Linn. = *Francolinus* Stephens, 1819.

Houppifere, monotypic, with *Phasianus ignifer* Shaw & Nodder as type (nec *Houppifer* Guérin-Meneville, 1829–38) = *Lophura* Fleming, 1822.

Jacamerops, monotypic, with *Alcedo grandis* Gmel. as type = *Jacamerops* Lesson, 1831.

Hoerataria, monotypic, with *Certhia vestiaria* "Shaw" (*i. e.* Latham) as type = *Vestiaria* Fleming, 1822.

If these names be considered tenable, they will affect three genera of North American Birds, namely, *Querquedula*, *Fuligula*, and *Clangula*, changing the date and authority of the first two without affecting the type, and replacing *Fuligula* with *Marila*.

Personally I am opposed to recognizing any of the names proposed by Oken in the paper here under notice, and would favor the reference of this and all similar cases to the International Commission on Zoölogical Nomenclature for arbitration, its decision to be recognized as final. In this case of Oken, the correlation of his names with Cuvier's groups is wholly inferential, or on the principle of exclusion, as Oken mentions no species as either the type or as a representative species of any of his group names; their tautonymic character it thus also inferential, though probable. On the other hand, the new names given are often not the names he adopts in his own classification. As an example, Les Cormorans Cuvier are called in the Cuvier column *Cormoran*, although Cuvier used for them the technical name *Phalacrocorax*, with *Carbo* and *Halieus* as alternatives or synonyms, while Oken, in his own classification, adopts *Halieus*.

clangula Linn. Antedates *Glaucion* Stejneger, 1885, with same type by original designation.

Cœligena Lesson, 1832. Type, *C.* (*Ornismya*) *cœligena* Less.

Fuligula Stephens, 1824. Type, *Anas cristata* Stephens ex Ray = *Anas fuligula* Linn.

Gallinago Koch, 1816. Type, *Scolopax gallinago* Linn.

Gallinula Brisson, 1760. Type, [*Gallinula*] *gallinula* Briss. = *Fulica chloropus* Linn.

Glottis Koch, 1816. Type, *G. natans* Koch = *Totanus glottis* Bechst. = *Scolopax nebularius* Gunn.

Himantopus Brisson, 1760. Type, [*Himantopus*] *himantopus* Briss. = *Charadrius himantopus* Linn.

Icterus Brisson, 1760. Type, [*Icterus*] *icterus* Briss. = *Oriolus icterus* Linn.

Ispida Brisson, 1760. Type, [*Ispida*] *ispida* Briss. = *Alcedo ispida* Linn. This species was erroneously designated as the type of *Alcedo* Linn. by Gray in 1840. Extralimital.

Jacana Brisson, 1760. Type, [*Jacana*] *jacana* Briss. = *Parra jacana* Linn.

Lagopus Brisson, 1760. Type, [*Lagopus*] *lagopus* Briss. = *Tetrao lagopus* Linn.

Limosa Brisson, 1760. Type, [*Limosa*] *limosa* Briss. = *Scolopax limosa* Linn.

Numenius Brisson, 1760. Type [*Numenius*] *numenius* = *Scolopax arquata* Linn.

Nyctea Stephens, 1826. Type, *N. erminea* (Shaw), = *Strix nyctea* Linn.

Nycticorax Stephens. Type, *Nycticorax europeus* Steph. = *Ardea nycticorax* Linn.

Nyroca Fleming, 1822. Type, *Anas nyroca* Güldenst. (*Nyroca* Fleming = *Aythya* Boie, preoccupied.)

Passer Brisson, 1760. Type, [*Passer*] *passer domesticus* Briss. = *Fringilla domestica* Linn. = *Pyrgita* Cuvier, 1817, with same type. The type of *Passer* by designation of the first reviser (Gray, 1840) is also *Fringilla domestica* Linn., but this act was subsequent to the founding of *Pyrgita* (1817), and is thus void. The type of *Passer* as currently accepted thus depends upon tautonomy and not on the first reviser.

Phalacrocorax Brisson, 1760. Type, [*Phalacrocorax*] *phalacrocorax* Briss. = *Pelecanus carbo* Linn.

Phalaropus Brisson, 1760. Type, [*Phalaropus*] *phalaropus* Briss. = *Tringa fulicaria* Linn. Antedates *Crymophilus* Vieill, 1816, monotypic, with same type.

Pica Brisson, 1760. Type, [*Pica*] *pica* Briss. = *Corvus pica* Linn.

Puffinus Brisson, 1760. Type, [*Puffinus*] *puffinus* Briss. = *Procellaria puffinus* Brünn. (1764) and Linn. (1766).

Pyrrhula Brisson, 1760. Type [*Pyrrhula*] *pyrrhula* Briss. = *Fringilla pyrrhula* Linn.

Querquedula Stephens, 1824. Type, *Anas circia* Linn. = *Anas querquedula* Linn.

Quiscalus Vieillot, 1816. Type, *Gracula quiscula* Linn.

Spinus Koch, 1816. Type, *Fringilla spinus* Linn.

Squatarola Cuvier, 1817. Type, *Tringa squatarola* Linn.

Stercorarius Brisson, 1760. Type, [*Stercorarius*] *stercorarius* Briss. = *Larus parasiticus* Linn.

Sula Brisson, 1760. Type [*Sula*] *sula* Briss. = *Sula piscator* Linn.

Tetrao Linnæus, 1758. Type, *T. tetrix* Linn., by "virtual tautonomy." Gray, in 1840, designated *T. urogallus* Linn. as type, the tautonymic type of *Urogallus* Scopoli, 1777, and of Fleming, 1822. Extralimital.

Totanus Bechstein, 1803. Type, *Scolopax totanus* Linn.

Tyrannus Lacépède, 1799. Type, *Lanius tyrannus* Linn.

Uria Brisson, 1760. Type, [*Uria*] *uria* Briss. = *Colymbus troile* Linn.

Urile Bonaparte, 1855. Type, *Phalacrocorax bicristatus* Pall. = *Pelecanus urile* Gmel. (part).

Vanellus Brisson, 1760. Type, [*Vanellus*] *vanellus* Briss. = *Tringa vanellus* Linn.

Zenaida Bonaparte, 1838. Type, *Columba zenaida* Bonap.

2. CASES IN WHICH THE GENERIC TYPE IS NOT ACCEPTED SOLELY UPON THE BASIS OF THE ORIGINAL PUBLICATION.

d. *Polytypic Genera with Type by Subsequent Designation.*

The following list includes only genera the determination of the types of which depends upon subsequent designation. In other words, genera containing more than one species when founded but for which no types were indicated by the founder at the time of the original publication of the genus.[1]

Acanthis Borkhausen, 1797. Type, *Fringilla linaria* Linn., by elimination. = *Acanthis* Bechstein, 1802, with same type by designation of Stejneger in 1884 (Auk, I, 145).

Acanthopneuste Blasius, 1858. Type, *Phyllopnueste borealis* Blasius by designation of Ridgway in 1904 (Bds. N. and Mid. Amer., III, 1904, 694).

---

[1] The references to Gray are to his several 'List of Genera of Birds,' 1840, 1841, 1855. In case the type by subsequent designation rests on some other author, the place of such designation is definitely stated.

Actitis Illiger, 1811. Type, *Tringa hypoleucos* Linn., by designation of the A. O. U. Nomenclature Committee in 1866. = *Actitis* Boie, 1822, monotypic, with *T. hypoleucos* Linn. as type, all the other species of the original genus being removed to other genera.

Ægialitis Boie, 1822. Type, *Charadrius hiaticula* Linn., by designation of Gray in 1855. *Ægialitis* was rejected by Gray in 1840 because of its supposed prior use in botany. In its place he adopted *Hiaticula* Moehr., with the same species as type.

Æstrelata Bonaparte, 1856. Type, *Procellaria hasitata* Kuhl, by designation of Coues in 1866 (Proc. Acad. Nat. Sci. Phila., 1866, 137).

Agelaius Vieillot, 1816. Type, *Oriolus phœniceus* Linn., by designation of Gray in 1840.

Aimophila Swainson, 1837. Type, *A. rufescens* Swains., by designation of Gray in 1840.

Aix Boie, 1822. Type, *Anas sponsa* Linn., by designation of Gray in 1840. *Dendronessa* Swainson, 1831, sometimes synonymized with *Aix*, has *Anas galericulata* Linn. as type by original designation.

Alauda Linnæus, 1758. Type, *Alauda arvensis* Linn., by designation of Swainson in 1827 (Zool. Journ., III, 1827, 344).

Alca Linnæus, 1758. Type, *Alca torda* Linn., by designation of the A. O. U. Nomenclature Committee in 1886. (*Torda* Duméril, 1806, is based on *Alca impennis* Linn. and has nothing to do with *Alca torda* Linn.; it is a strict synonym of *Plautus* Brünn., 1772, and has been so synonymized by leading systematists for many years.

Ammodramus Swainson, June, 1827. Type, *Fringilla caudacuta* Wils. = *Oriolus caudacutus* Gmel., by designation of the founder in November, 1827.

A number of genera were founded by Swainson in 1827 under such peculiar circumstances that they require special consideration. These genera are *Vermivora*, *Tiaris*, *Ammodramus*, *Xiphorhynchus*, and *Lampornis*. They appeared first in a paper on the Bullock collection of Mexican birds. This paper was published in two parts, in the May and June numbers of the 'Philosophical Magazine' (new ser., I, pp. 364–369, May, 1827, and pp. 433–442, June, 1827). Another paper had been previously written and sent for publication to the 'Zoological Journal,' containing diagnoses of several genera, with explicit designation of their types, which first appeared in the paper on Mexican birds. The first-written paper was unexpectedly long delayed in publication, greatly to the disappointment of the author, as he has stated, who was powerless to prevent the inopportune delay. This paper was also published in two parts, in the 'Zoological Journal' (III, pp. 158–175) April–July, 1827, and pp. 343–363, August–November, 1827).

The Mexican collection contained birds referred to some of the new genera described in the 'Zoological Journal' paper, and, in lieu of describing these genera over again here, the author gave a reference to the other paper, giving as full a citation as possible, omitting only the page, in each case, as follows: "*Swains. in Zool. Journ.* No. 10," where a full description is given and a type designated. In several instances the species referred in the 'Philosophical Magazine' paper to these new genera are different from the species the author designated as the type; sometimes several were thus referred, sometimes only one. In the latter case the genus was monotypic when it appeared in May or June in the 'Philosophical Magazine,' two or five months (as the case may be) ahead of its intended first publication in the 'Zoological Journal,' and thus has in this actual first publication a basis by both priority and monotypy. In the former case, where several species were referred to one of the new genera, the first publication of the generic name fails to establish the type, which rests on subsequent designation by the author two or five months later.

The type by designation of the author has been universally recognized as the type in all these cases for three fourths of a century. The genera in question are for the most part large groups, as modern genera go, each containing several species and many subspecies. To now wrest from these genera their long-recognized types by the strict enforcement of a technicality, against palliative circumstances, will produce serious confusion in the nomenclature of these groups. If the author had failed to give a reference to the place of publication of the diagnoses and types, the latter obviously selected before the other paper was published, the case would be quite different. The author did all he could to establish his types, and his reference to the place of their publication makes them virtually types by original designation. I therefore prefer in the present connection to take the types designated by the author in preference to the fortuitous and unintentioned types resulting from the earlier publication of a later written paper. As this course is, however, opposed to the views of some of my colleagues, I respectfully offer this unique case to the Nomenclature Commission of the International Zoological Congress for final arbitration.

If the case is decided adversely to the types designated by the author in a paper intended to be the first place of publication of these genera, the following changes will result.

Helminthophila will be replaced by *Vermivora*, properly a synonym of *Helmitheros*.

Tiaris will be replaced by *Euetheia* Reichenb. 1850, and *Euetheia* will be replaced by *Charitospiza* Oberholser, 1905, based on the type of *Tiaris* as designated by the founder.

Ammodramus will be replaced by the later genus *Coturniculus*, and the group recognized for 75 years as *Ammodramus* becomes *Ammospiza* Oberholser, 1905, with the type designated by the founder of *Ammodramus* as the type of that genus, or by *Passerherbulus* Maynard, 1895, with the type a species congeneric with the type of *Ammodramus*.

Xiphorhynchus will replace *Dendrornis* Eyton, 1852, which is reduced to synonymy, and the group known universally for 75 years takes the new name *Xiphornis* Oberholser, 1905.

Lampornis will replace *Oreopyra* Gould, 1861, and the group universally recognized as *Lampornis* for 75 years will take the name *Anthracothorax* Boie, 1831.

In the 'Philosophical Magazine' paper (*l. c.*, p. 462) Swainson referred to it only the single species *Lampornis amethystinus* Swains. (not *Trochilus amethystinus* Gmel.), which subsequent writers appear to have wholly overlooked, as it is not cited by any of the recent monographers of the Trochilidæ. The species is evidently *Oreopyra calolæma* Salvin, 1864, a species considered congeneric with *Oreopyra leucaspis* Gould, 1861, which should apparently be known as either *Lampornis amethystina* Swains. or *Oreopyra amethystina* (Swains.).

In his later description of the genus *Lampornis* (Zool. Journ., III, 1827, 358, Swainson referred to it three species, without designating either as the type, and without including the species originally referred to it. The type was subsequently designated by the founder in 1837 (Class. Bds., II, 330) as *Trochilus mango* Linn., which species has since always been accepted as the type.

It should be added that Swainson's *L. amethystinus* was doubtless wrongly attributed to Mexico, as the genus *Oreopyra* Gld. is apparently not found north of Costa Rica. In like manner his *Cynanthus minimus*, described as a new species and not since recognized by monographers, was apparently based on a specimen of *Mellisuga minima* (Linn.), a West Indian species. *Cf.* Allen, this Bulletin, XXIII, 1907, 347, footnote.

Ampelis Linnæus, 1766. Type, *Ampelis pompadora* Linn., by elimination, no type having been correctly determined by subsequent designation. (See *antea*, p. 12.)

Anas Linnæus, 1758. Type, *Anas boschas* Linn., by designation of Gray in 1840. = *Boschas* Swainson, 1831, tautonymic, with same type. Before Swainson established *Boschas* in 1831, the genus *Anas* had been restricted by general consent to *Anas boschas* and closely allied (strictly congeneric) species, as it has been by all authors since. Gray, in designating *A. boschas* as the type, in 1840, only followed the general usage. Swainson's action in 1831, making *A. clypeata* the type of *Anas*, is obviously invalid, since *clypeata* was already the type of the monotypic genus *Spatula* Boie, 1822.

Anous Stephens, 1826. Type, *Anous niger* Steph. (not *Sterna nigra* Linn., as alleged by Stone [1]) = *Sterna stolida* Linn., by designation of Gray in 1840. (*Cf.* Strickland, Ann. and Mag. Nat. Hist., VII, May, 1841, 40; also Saunders, Brit. Mus. Cat. Bds., XXV, 1896, 136, 137.)

---

[1] Science, N. S., XXVI, 445, Oct. 4, 1907.

Anthus Bechstein, 1807. Type, *Anthus aquaticus* Bechst. = *Alauda spinoletta* Linn., by designation of Swainson in 1837 (Class. Bds., II, 249).

Antrostomus Bonaparte (ex Gould MS.), 1838. Type, *Caprimulgus carolinensis* Gmel., by designation of Gray in 1840.

Aphelocoma Cabanis, 1851. Type, *Garrulus californicus* Vigors, by designation of Sharpe in 1877 (Brit. Mus. Cat. Bds., 1877, 112).

Ardea Linnæus, 1758. Type, *Ardea cinerea* Linn., by designation of Gray in 1840.

Astragalinus Cabanis, 1851. Type, *Fringilla tristis* Linn., by designation of Gray in 1855.

Astur Lacépède, 1801. Type, *Falco palumbarius* Linn., by designation of Vigors, 1825 (Zool. Journ., I, Oct. 1824, 326).

Atthis Reichenbach, 1853. Type, *Ornismya heloisæ* Less. & Delatt., by designation of Gray in 1855.

Basilinna Boie, 1831. Type, *Trochilus leucotis* Vieill., by designation of Gray in 1855.

Bonasa Stephens, 1819. Type, *Tetrao umbellus* Linn., by designation of Gray in 1840. Antedates *Hylobrontes* Stone, 1907, with same type.

Botaurus Stephens, 1819. Type, *Ardea stellaris* Linn., by designation of Gray in 1840.

Brachyramphus Brandt, 1837. Type, *Colymbus marmoratus* Gmel., by designation of Gray in 1840.

Branta Scopoli, 1769. Type, *Anas bernicla* Linn., by designation of Bannister in 1870 (Proc. Acad. Nat. Sci. Phila., 1870, 131).

Calypte Gould, 1856. Type, *Ornismya costæ* Bourc., by designation of Elliot in 1879 (Mon. Trochil., 106).

Carpodacus Kaup, 1829. Type, *Loxia erythrina* Linn., by designation of Gray in 1855. = *Erythrina* Brehm, 1828, with same type, preoccupied by *Erythrinus* Gron. 1763.

Catharista Vieillot, 1816. Type, *Vultur urubu* Vieill., by designation of Sharpe in 1874 (Brit. Mus. Cat. Bds., I, 23). *Catharista* originally included only two species, and the other (*aura*) is type of *Cathartes*, both by subsequent designation and elimination.

Cathartes Illiger, 1811. Type, *Vultur aura* Linn., by designation of Vigors in 1825 (Zool. Journ., II, Oct. 1825, 384). Antedates *Rhinogryphus* Ridgway, 1874, and *Œnops* Sharpe, 1874, both with same type.

Certhia Linnæus, 1758. Type, *Certhia familiaris* Linn., by designation of Swainson in 1837 (Class. Bds., II, 312) and by Gray in 1840.

Ceryle Boie, 1828. Type, *Alcedo rudis* Linn., by designation of Gray in 1840.

Chætura Stephens, 1825. Type, *Chætura macroptera* Swains. = *Hirundo* *caudacuta* Lath., by designation of Swainson in 1837 (Class. Bds., II, 340). Not *Cypselus spinicaudus* Temm. as designated by Gray in 1855, this being not one of the original species.

Charadrius Linnæus, 1758. Type, *C. apricarius* Linn., by designation of Gray in 1840.

Chloroceryle Kaup, 1848. Type, *Alcedo amazona* Lath., by designation of Gray in 1840.

Circus Lacépède, 1801. Type, *Falco æruginosus* Linn., by designation of Lesson in 1828 (Man. d'Orn., I, 1828, 105) and by Gray in 1840. Gray changed his designation of type in 1855 to *F. cyaneus* Linn., a species congeneric with *F. æruginosus.*

Cistothorus Cabanis, 1850. Type, *Troglodytes stellaris* Licht., by designation of Gray in 1855.

Colaptes Swainson, June, 1827. Type, *Cuculus auratus* Linn., by designation of the founder in November, 1827.

Columba Linnæus, 1758. Type, *C. palumbus* Linn., by designation of Swainson in 1837 (Class. Bds., II, 348) and of Gray in 1840. The type by elimination falls on a congeneric species — *C. œnas β domestica* Linn. = *C. livia* Bonn., the species designated by Gray in 1855 as the type.

Columbina Spix, 1825. Type, *Columba passerina* Linn., by designation of Gray in 1840. Antedates *Chæmepelia* Swains. 1827, with same type by designation of Gray in 1841. Replaces *Columbigallina* Boie, 1826 (nec Oken, 1817, indeterminable), monotypic, with same type.

Colymbus Linnæus, 1758. Type *Colymbus cristatus* Linn., by designation of the A. O. U. Nomenclature Committee in 1886. Not *Colymbus glacialis* Linn. as designated by Swainson in 1837 and by Gray in 1840, this species being not one of the original species.

Compsothlypis Cabanis, 1850. Type, *Parus americanus* Linn.. by designation of Gray in 1855.

Conurus Kuhl, 1820. Type, "*Conurus vittatus* (Shaw)" = *Psittacus vittatus* Shaw, by designation of Gray in 1840. = *Pyrrhura* Bonaparte, 1856, with same type. Not *Conurus* Lesson, 1828, with type, by original designation, "*Psittacus rufirostris* L. enl. 550" = *Psittacus torquatus* Bodd., which is the originally designated type of *Palæornis* Vigors, 1825. Extralimital.

Not *Conurus* Bonaparte, 1850, type *Psittacus carolinensis* Linn., the only described species referred to it, and thus monotypic; nor *Conurus* A. O. U. Nomenclature Committee, 1886, with same type by elimination.

Not *Conurus* Gray, 1855, type, by designation, "*Psittacus guianensis* Linn." = *P. leucophthalmus* Müller; nor *Conurus* Salvadori, 1891, with the same type by designation = *Psittacara* Vigors, 1825 with same type by original designation. In this connection the following related genera may be considered:

[**Aratinga** Spix, 1824. Type, *Aratinga cyanogularis* Spix = *Psittacus cruentatus* Wied, by designation of Bonaparte in 1854 (Rev. et Mag. de Zool., 1854, 150). Not *Aratinga* Bonaparte, 1856, monotypic, with *Psittacus guarouba* Gmel. as type; antedated by *Guarouba* Lesson, 1831, with same type by tautonomy. *Aratinga* Spix antedates *Pyrrhura* Bonaparte, 1856, with *Psittacus vittata* Shaw as type, this species being congeneric with the type of *Aratinga* as designated by Bonaparte in 1854.]

[**Psittacara** Vigors, 1825. Type, *Psittacus guianensis* Gmel. = *P. leucophthalmus* Müller, by original designation, later made the type of *Conurus* by Gray in 1855 (not 1840) and by Salvadori in 1891.]

Corvus Linnæus, 1758. Type, *C. corax* Linn., by designation of Gray in 1840.

Coturniculus Bonaparte, 1838. Type, *Fringilla passerina* Wils., by designation of Gray in 1840.

Cuculus Linnæus, 1758. Type, *C. canorus* Linn., by designation of Swainson in 1837 (Class. Bds., II, 322) and of Gray in 1840.

Cynanthus Swainson, 1827. Type, *C. latirostris* Swain., by designation of Stone (Auk, XXIV, 1907, 192) and Allen (Bull. Am. Mus. Nat. Hist., XXIII, 1907, 347) in 1907. = *Circe* Gould, 1857 (preoccupied), and *Iache* Elliot, 1879, both with same type.

Cypseloides Streubel, 1848. Type, *Hemiprocne fumigata* Streubel, by designation of Sclater in 1865 (P. Z. S., 1865, 614).

Cyrtonyx Gould, 1850. Type, *Ortyx montezumæ* Vig., by designation of Gray in 1855.

Dendrocygna Swainson, 1837. Type, *Anas arcuata* Horsf., by designation of Gray in 1840.

Diomedea Linn. 1758. Type, *D. exulans* Linn., by designation of Swainson in 1837 (Class. Bds., II, 373) and of Gray in 1840.

Dysporus Illiger, 1811. Type, *Pelecanus bassanus* Linn., by designation of Swainson in 1837 and Ogilvie-Grant in 1898 (Brit. Mus. Cat. Bds., XXVI, 423).

Ectopistes Swainson, 1827. Type, *E. migratoria* Swains. = *Columba migratoria* Wilson, by designation of the founder in 1837 (Class. Birds, II, 1837, 348).

Euphonia Demarest, 1805. Type, *Pipra musica* Gmel., by designation of Gray in 1840.

Falco Linnæus, 1758. Type, *Falco subbuteo* Linn., by designation of the A. O. U. Nomenclature Committee in 1886. Not *F. peregrinus* as designated by Gray in 1840, this being not one of the original species.

Fulica Linnæus, 1758. Type, *Fulica atra* Linn., by designation of Gray in 1840.

Fulmarus Stephens, 1826. When Gray, in 1855, designated *Procellaria* *glacialis* Linn. as type of *Fulmarus,* it was the monotypic type of *Rhantistes* Kaup, 1829. As *Procellaria gigantea* Gmel. became the monotypic type of *Ossifraga* Homb. & Jacq. in 1844, the only species left of the three original species of *Fulmarus* after this date was *Procellaria antarctica* Gmel., which is therefore necessarily its type. Consequently *Fulmarus* must replace *Thalassœca* Reich. 1852, based on *P. antarctica* Gmel. The long recognition of *Procellaria glacialis* as type of *Fulmarus* is due to Gray's overlooked error in designating it as the type in 1855, and improperly citing *Rhantistes* as a synonym of *Fulmarus.* Extralimital.

Gavia Forster, 1788. Antedates *Urinator* Cuvier, 1800; type *Colymbus imber* Gunn., by designation of A. O. U. Committee in 1886.

Geothlypis Cabanis, 1847. Type, *Turdus trichas* Linn. To replace *Trichas* Swainson, 1827, preoccupied, with the same type by tautonomy and subsequent designation by the founder.

Geotrygon Gosse, 1847. Type, *G. sylvatica* Gosse (by inference) = *Columba cristata* Temm. & Knip (nec. Gmel.) = *C. versicolor* Lafr., by designation of Gray in 1855.

Glaucidium Boie, 1826. Type, *Strix passerina* Linn., by designation of Gray in 1840. = *Noctua* Savigny, 1809, and *Athene* Boie, 1822, both preoccupied.

Grus Pallas, 1766 (or, preferably, Duméril, 1806). Type, *Ardea grus* Linn., by designation of Gray in 1840. The genus is thus tautonymic by subsequent designation of a type, the genus resting originally on a diagnosis only. (*Cf.* Allen, Bull. Amer. Mus. Nat. Hist., XXIII, 1907, 313.)

Guiraca Swainson, 1827. Type, *Loxia cærulea* Linn., by designation of Gray in 1840.

Gypagus Vieillot, 1816. Type, *Vultur papa* Linn., by designation of Sharpe in 1874 (Cat. Bds. Brit. Mus., I, 22), and A. O. U. Committee in 1886. As *Vultur papa* became type of *Sarcorhamphus* of Duméril by subsequent designation by Vigors in 1825, *Gypagus* is a synonym *Sarcorhamphus.*

Heleodytes Cabanis, 1850. Type, *Furnarius griseus* Swains., by designation of Gray in 1855.

Helinaia Audubon, 1839. Type, *Sylvia swainsonii* Aud., by designation of Coues in 1878 (Bds. Col. Vall., 212).

Helminthophila Ridgway, 1882. Type, *Sylvia rubricapilla* Wilson. To replace *Helminthophaga* Cabanis, 1850, with same type by designation of Gray in 1855.

Hirundo Linnæus, 1758. Type, *H. rustica* Linn., by designation of Swainson in 1837 (Class. Bds., II, 340) and by Gray in 1840.

Herodias Boie, 1822. Type, *Ardea egretta* Gmel., by designation of Gray in 1855.

Hydrochelidon Boie, 1822. Type, *Sterna nigra* Linn., by designation of Strickland in 1841. Antedates *Viralva* Stephens (ex Leach MS.), 1825, with same type by designation of Strickland in 1841 (Ann. and Mag. Nat. Hist., VII, 40). *Hydrochelidon* was based exclusively on the two strictly congeneric species *Sterna nigra* Linn. and *S. leucoptera* M. & S., one of which must be its type.

Ixobrychus Bilberg, 1828. Type, *Ardea minuta* Linn., as designated by Stone in 1907 (Auk, April, 1907, 192). Antedates *Ardetta* Gray, 1842, monotypic, with same type. *Ixobrychus* originally contained two species: *Ardea minuta* Linn. and *A. stellaris* Linn. As Gray designated *A. stellaris* as type of *Botaurus* in 1840, only *A. minuta* was left in *Ixobrychus*, which thus became its type, so that Gray was in error when in 1842 he proposed *Ardetta* with *A. minuta* as its type and only species.

Lanius Linnæus, 1758. Type, *L. excubitor* Linn., by designation of Swainson in 1824 (Zool. Journ., I, Oct. 1824, 294).

Larus Linnæus, 1758. Type, *L. canus* Linn., by designation of Gray in 1855. In 1840 Gray designated *Larus glaucus* Brünn. as type, not described till six years after the genus was founded.

Lophortyx Bonaparte, 1838. Type, *Tetrao californicus* Shaw, by designation of Gray in 1840.

Loxia Linnæus, 1758. Type, *L. curvirostra* Linn., by virtual designation of Brisson in 1760, whose sole species of *Loxia* was *L. curvirostra* Linn. Also by designation of Gray in 1840, but before Gray designated the type, Brehm (1827) had founded *Curvirostra* for the Crossbills, of which *Loxia curvirostra* is type by tautonomy. Hence, properly the type of *Loxia* Linn. is *L. curvirostra* by virtual designation of Brisson, 1760.

Lunda Pallas, 1811. Type, *Alca cirrhata* Pallas, by designation of Gray in 1840.

Mareca Stephens, 1824. Type, *Anas penelope* Linn., by designation of Gray in 1840.

Megaquiscula Cassin, 1866. Type, *Quiscalus major* Vieill., by designation of Sclater in 1886 (Brit. Mus. Cat. Bds., XI, 1866, 393).

Melanitta Boie, 1822. Type, *Anas fusca* Linn., by designation of Gray in 1840.

Meleagris Linnæus, 1758. Type, *M. gallopavo* Linn., by designation of Gray in 1840. Antedates *Gallopavo* Brisson, 1760.

Melopelia Bonaparte, 1854. Type, *Columba meloda* Tsch., by designation of Gray in 1855.

Mergus Linn. 1758. Type, *Mergus castor* Linn. = *M. merganser* Linn., by designation of Swainson in 1837 (Class. Bds., II, 369) and of Gray in 1840. Antedates *Merganser* Brisson, 1760.

Motacilla Linnæus, 1758. Type, *M. alba* Linn., by designation of Gray in 1840.

Myiarchus Cabanis, 1844. Type, *Muscicapa ferox* Gmel., by designation of Gray in 1855.

Oidemia Fleming, 1822. Type, *Anas nigra* Linn., by designation of Gray in 1840.

Olor Wagler, 1832. Type, *Anas cygnus* Linn., by designation of Gray in 1840.

Oporornis Baird, 1858. Type, *Sylvia agilis* Wils., by designation of the founder in 1865 (Rev. Am. Bds., 218).

Ortalis Merrem, 1786. Type, *Phasianus motmot* Linn., by designation of Gray in 1840. (Not seen.)

Parus Linnæus, 1758. Type, *Parus major* Linn., by designation of Gray in 1840.

Passerculus Bonaparte, 1838. Type, *Fringilla savanna* Wils., by designation of Gray in 1840.

Passerina Vieillot, 1816. Type, *Tanagra cyanea* Linn., by designation of Gray in 1840. Antedates *Cyanospiza* Baird, 1858, with same type by original designation.

Pelecanus Linnæus, 1758. Type, *P. onocrotalus* Linn., by designation of Swainson in 1837 (Class. Bds., II, 372) and of Gray in 1840.

Pelidna Cuvier, 1817. Type, *Tringa alpina* Linn., by designation of Coues in 1861 (Proc. Acad. Nat. Sci. Phila., 1861, 187).

Pendulinus Vieillot, 1816. Type, *Oriolus spurius* Linn., by designation of A. O. U. Nomenclature Committee in 1886; not *O. banana* Linn., as designated by Gray in 1855, this being not one of the original species.

Perisoreus Bonaparte, 1831. Type, *Corvus canadensis* Linn., by designaton of Gray in 1840.

Petrochelidon Cabanis, 1850. Type, *Hirundo melanogaster* Swains., by designation of Gray in 1855.

Peucæa Audubon, 1839. Type, *Fringilla bachmani* Aud., by designation of Gray in 1855.

Phaëthon Linnæus, 1758. Type, *P. æthereus* Linn., by designation of Gray in 1840.

Phaleris Temminck, 1820. Type, *Alca psittacula* Pall., by designation of Swainson in 1837 (Class. Bds. II, 371) and of Gray in 1840. (Not *Phaleris* of the A. O. U. Check-List, 1st and 2d editions.) Antedates *Cyclorrhynchus* Kaup, 1829, monotypic, with same type.

Picoides Lacépède, 1801. Type, *Picus tridactylus* Linn., by designation of Gray in 1840. *Picoides,* though originally based on a diagnosis without mention of any species, is clearly monotypic, with type as given above, this being the only three-toed woodpecker known when the genus was founded.

Planesticus Bonaparte, 1854. Type, *Turdus jamaicensis* Gmel., as designated by Baird in 1864 (Rev. Am. Bds., 12). = *Merula* Leach, 1816, tautonymic, with *Turdus merula* Linn. as type, preoccupied by *Merula* Koch, 1816, = *Pastor* Temm. 1815, with *Turdus roseus* Linn. as type.

Polioptila Sclater, 1855. Type, *Motacilla cærulea* Linn., by designation of Gray in 1855, and as implied by the founder. = *Culicivora* Swainson, 1837, not of Swainson, 1827.

Priofinus Hombron & Jacquinot, 1844. Type, *Procellaria cinerea* Gmel., by designation of Gray in 1855.

Procellaria Linn., 1758. Type, *P. æquinoctialis* Linn., by designation of Gray in 1840.

Pyrocephalus Gould, 1841. Type, *Muscicapa coronata* Gmel. = *M. rubinus* Bodd., by designation of Gray in 1840.

Rallus Linnæus, 1758. Type, *Rallus aquaticus* Linn., by designation of Gray in 1840. = *Rallus* Bechstein, 1802, and of Boie, 1822; each of these authors restricted *Rallus* to *R. aquaticus* by transferring all of the other original species to other genera, this action, in each case, being tautamount to a 'designation' of *R. aquaticus* as the type of *Rallus*.

Rhyacophilus Kaup, 1829. Type, *Tringa glareola* Linn., by designation of Gray in 1855.

Rhynchodon Nitzsch, 1829. Type, *Falco peregrinus* Latham, by designation of the A. O. U. Nomenclature Committee in 1886.

Salpinctes Cabanis, 1847. Type, *Troglodytes obsoletus* Say, by designation of Gray in 1855.

Sarcorhamphus Duméril, 1806. Type, *Vultur papa* Linn., by designation of Vigors in 1825 (Zool. Journ., II, 381, 384). Replaces *Gypagus*.

Saxicola Bechstein, 1803. Type, *Motacilla œnanthe* Linn., as designated by Gray in 1840.

Scardafella Bonaparte, 1854. Type, *Columba squamosa* Temm., by designation of Gray in 1855.

Scolopax Linnæus, 1758. Type, *S. rusticola* Linn., by designation of Gray in 1840, and as restricted by Koch in 1816. *S. rusticola* is also type by tautonomy of *Rusticola* Vieillot, 1816. Of the several Linnæan species of *Scolopax* found in Bavaria, Koch (Syst. Baier. Zool., I, 1816, p. 310) removed from it all except *rusticola*, making a new (tautonymic) genus for one of them (*S. gallinago*) and placing all the others except *rusticola* in other genera. But he of course formally 'designated' no type. There is thus the alternative of taking Vieillot's tautonymic genus *Rusticola*, of ostensibly[1] the same date with Koch's restriction, and ignoring Koch, thus overthrowing Gray's much later designation of a type, and contravening general usage for nearly a century. Only by respecting Koch's virtual designation of a type for *Scolopax* in 1816 can the traditional type of *Scolopax* be preserved.

---

[1] It has been claimed that Vieillot's 'Analyse,' in which *Rusticola* was proposed, was not published till 1817. *Cf.* Lesson, Man. d'Orn., I, 1828, 50, footnote.

Scotiaptex Swainson, 1837. Type, *Strix cinerea* Gmel. = *S. nebulosa* Forster, by designation of the A. O. U. Nomenclature Committee in 1889 (First Suppl. A. O. U. Check-List, 1889, 21).

Seiurus Swainson, May, 1827. Type, *Motacilla aurocapillus* Linn., by designation of the founder in July, 1827.

Selasphorus Swainson, 1831. Type, *Trochilus rufus* Gmel., by designation of Gray in 1855.

Setophaga Swainson, May, 1827. Type, *Muscicapa ruticilla* Linn., by designation of the founder in November, 1827.

Sialia Swainson, May, 1827. Type, *Motacilla sialis* Linn., by designation of the founder in November, 1827.

Spiza Bonaparte, 1824. Type, *Emberiza americana* Gmel., by designation of the founder in 1827 (Specch. Comp. della Orn. di Roma e di Filadelfia, 1827, 47, footnote). Antedates *Euspiza* Bonap., 1832, with same type.

Sporophila Cabanis, 1844. Type, *Pyrrhula cinereola* Temm. = *Fringilla hypoleuca* Licht., by designation of Sharpe, 1888 (Brit. Mus. Cat. Bds., XII, 1888, 90); not *Pyrrhula falcirostris* Temm. sp. indet., as designated by Gray in 1855. Established as a substitute for *Spermophila* Swainson, 1827 (preoccupied), and therefore *Sporophila* takes the same type. As *Spermophila* originally contained only two species, and one of them has proved to be indeterminable, the type is necessarily the other = *Fringilla hypoleuca* Licht.

Streptoceryle Bonaparte, 1854. Type, *Alcedo torquata* Linn., by designation of Gray in 1840.

Strix Linnæus, 1758. Type, *Strix flammea* Linn., by designation of Lesson in 1828 (Man. d'Orn., I, 1828, 114) and of Gray in 1840.

Sturnus Linnæus, 1735. Type, *S. vulgaris* Linn., by designation of Swainson in 1837 and of Gray in 1840.

Synthlyboramphus Brandt, 1837. Type, *Alca antiquus* Gmel., by designation of Gray in 1840.

Tachycineta Cabanis, 1850. Type, *Hirundo thalassina* Swains., by designation of Gray in 1855.

Thalasseus Boie, 1822. Type, *Sterna caspia* Pallas, by designation of Gray in 1855, and long previously by elimination, the other two of the three species becoming the types of monotypic genera, respectively, in 1829 and 1830. In 1840 Gray erroneously designated *S. cantiaca*, this species having been made the type of the monotypic genus *Actochelidon* Kaup, 1829, a genus evidently unknown to Gray in 1840, since in 1855 he not only recognized *Actochelidon* with *cantiaca* as type, but changed the type of *Thalasseus* from *cantiaca* to *caspia*.

Tiaris Swainson, June, 1827. Type, *Fringilla ornata* Wied, by designation of the founder in November, 1827.

Tinnunculus Vieillot, 1807. Type, *Falco columbarius* Linn., by designation of A. O. U. Nomenclature Committee in 1903 (Auk, XX, 1903, 339). Not *Falco tinnunculus* Linn., as designated by Gray in 1840, this being not one of the original species.

Tringa Linnæus, 1758. Type, *Tringa canutus* Linn., by designation of Gray in 1840. The case of *Tringa* is nearly parallel with that of *Scolopax* (*q. v.*), *T. canutus* being already the tautonymic type of *Canutus* Brehm (1831) when Gray made it 'type by subsequent designation' of *Tringa* in 1840. As, however, *T. canutus* was the last species removed from *Tringa*, it is its type both by elimination and subsequent designation.

Trochilus Linnæus, 1758. Type, *Trochilus polytmus* Linn., by designation of Gray in 1840. Antedates the monotypic genus *Aithurus* Cab. 1860, with same type. (See *antea*, p. 12). Swainson in 1837 (Class. Bds., II, 330) gave "*T. longirostris* auct." as type, but this was not one of the original species.

Troglodytes Vieillot, 1807 (= 1808). Type, *T. aëdon* Vieill., by designation of Oberholser in 1902 (Auk, XIX, 175, 176). Not *Troglodites* Cuvier, 1817.

Turdus Linnæus, 1758. Type, *Turdus viscivorus* Linn., by designation of Gray in 1840.

Uranomitra Reichenbach, 1853. Type, *Trochilus franciæ* B. &. M., 1846, by designation of Elliot in 1879 (Synop. Trochil., March, 1879, 195).

Vermivora Swainson, June, 1827. Type, *Sylvia vermivora* Wils., by designation of the author in November, 1827. Antedated by *Helmitheros* Rafinesque, 1819, monotypic, with the same type. (See *antea*, pp. 29–31.)

Vireo Vieillot, 1807. Type, *Muscicapa noveboracensis* Gmel., by designation of Gray in 1840.

Vireosylva Bonaparte, 1838. Type, *Muscicapa olivacea* Linn., by designation of Gray in 1840.

Wilsonia Bonaparte, 1838. Type, *Motacilla mitrata* Gmel., by designation of A. O. U. Nomenclature Committee in 1899 (Auk, XVI, 1899, 123).

Xanthoura Bonaparte, 1850. Type, *Corvus peruanus* Gmel. = *C. yncas* Bodd., by designation of Gray in 1855.

Yphantes Vieillot, 1816. Type, *Oriolus baltimore* Linn., 1766. = *Coracias galbula* Linn., 1758, by designation of Gray in 1855.

Zonotrichia Swainson, 1831. Type, *Fringilla pennsylvanica* Lath. = *F. albicollis* Gmel., by designation of Bonaparte in 1832 (Sagg. Distr. Metod. Anim. Vertebr., 1832, 83).

III. Summary.

An analysis of the foregoing lists of genera and subgenera yields results of interest. A few exotic genera are included, but 429 of the 442 formally considered are represented in the A. O. U. Check-List area of North America.

Monotypic genera, or those containing only a single species when founded	236
Polytypic genera, or those containing two or more species when founded	206
	442
Polytypic genera with type by original designation	25
Polytypic genera with type by absolute tautonomy	44
Polytypic genera with type by subsequent designation	137
	206

Of these 442 genera and subgenera, 71 per cent. have the type determinable on the basis of the original description, and in 29 per cent. the determination of the type depends upon subsequent conditions.

In the monotypic genera, which exceed 56 per cent. of the total, the type is fixed automatically at the time the genus is founded. About one third of the monotypic genera have the type also designated by the founder, and in about one tenth the type is also tautonymic.

Of the polytypic genera, the type is found to depend upon the designation of the founder at the time of the original publication of the genus in slightly over 12 per cent. of the cases, and upon absolute tautonomy in 21 per cent. of the cases. This leaves 66 per cent. in which type determination rests upon subsequent action by the founder or by some other author.

A careful analysis of the list of polytypic genera shows that the type is absolutely determinable by elimination, in its most restricted sense, in only 94 out of 139 cases, or in a little more than 67 per cent. The cases to which restricted elimination does not apply are: (1) genera based solely on a diagnosis; (2) genera containing originally only congeneric species; (3) genera containing two or more congeneric species after the noncongeneric species have been removed. These three categories form 33 per cent. of the total number of polytypic genera, in which the type is necessarily established solely on the basis of subsequent designation. In the case of many of the early genera, the type was established by elimination 20 to 50 years or more before any species became "type by subsequent designation" as defined under rule *g* of Article 30 of the International Code.

Restricted elimination is difficult to apply in the case of some of the large Linnæan genera, where, through the action of such ultra splitters as

Boie, Kaup, Brehm, Bonaparte, Reichenbach, and others, of the middle of the last century, every species became the type of some so-called genus or subgenus,— in some instances the type of several such divisions,— now rated as nominal. Only by relegating these to synonymy can a type be selected by elimination which will be the same as the type now accepted by general consent. In several cases the species which have come to be the unanimously accepted types of these genera became so by the restriction of the original genus by some early author to one of its species, as in *Loxia*, *Actitis*, and *Scolopax*, a proceeding tantamount to 'type by subsequent designation,' though not so recognized by Article 30.

In the present paper, when the designation of a type by a first reviser has been made in contravention of all official rules of nomenclature, from 1842 to 1905, and of the new Article 30 of the International Code when logically construed, such designations have been rejected as invalid. Illustrations, taken from Gray, have already been given (pp. 10–13) of invalid types by subsequent designation. The two principal sources of such errors are: (1) the designation of a species as a type which was not one of the originally included species of the genus; (2) the selection of a type which was already the type of some other genus. These errors were frequently committed by Gray's predecessors in type designation, as well as by Gray himself; but Gray, as already stated (*antea*, p. 8), corrected most of his errors in type fixing, and his corrections have been accepted by subsequent authors, while his erroneous determinations of types have been as uniformly rejected. Thus, to mention a few cases among many, he designated as types of *Colymbus*, *Larus*, *Falco*, *Tinnunculus*, *Vultur*, and *Troglodytes* species not originally included in them, and for *Alca*, *Thalasseus*, *Fulmarus*, *Tetrao*, *Cyanocitta*, and *Ampelis*, species that had long before become the types of other genera.

To make a fetish of the 'type by subsequent designation' rule, and give it precedence over all other rules, would be not only revolutionary but grossly illogical, resulting in the needless overturn of a large number of genera long accepted in their present sense. And without any compensating advantages whatever, for type by first subsequent designation, right or wrong, is no more a hard and fast rule than type by subsequent designation in conformity to rules *a–d* of Article 30. The two methods are also on an absolute parity in respect to facility of enforcement.

Of the 197 polytypic genera and subgenera of the A. O. U. Check-List, 8 become changed through the determination of the type by rule *g* of the new Article 30 of the International Code of Nomenclature, namely, *Fulmarus*, *Procellaria*, *Mergus*, *Gypagus*, *Conurus*, *Trochilus* *Ampelis*, and *Passerina*, in each case the type species being different from that reached by restricted elimination. In the case of *Fulmarus*, *Procellaria*, and *Ampelis*, elimination, for the A. O. U. Check-List, was based on the "non-exotic species" rule (A. O. U. Code, Canon XXIII; International Code of 1905, Article 30, recommendation *c*), which provides that "the process of elimination is to be restricted to the non-exotic species," from the standpoint of the author. In each of these genera there was only one non-exotic species, which was hence the type, but they would not have been types under unrestricted elimination. In the case of *Trochilus*, elimination fails to give satisfactory results, and the hitherto current type rests on general usage, or "consensus of opinion." In the *Mergus*, *Gypagus*, *Conurus*, and *Passerina* cases, the type by elimination is changed by the "type by subsequent designation" rule = 5 instances in a total of 197 genera.

On the other hand, to take the species *first* made the type by subsequent designation, *right or wrong*, many additional and wholly superfluous changes in generic names would be necessary, of which the following may serve as examples, based on Gray's work as a first reviser. If Swainson and others were also included, many changes additional to those here given would probably be required. The following illustrations also exclude genera the types of which by subsequent designation were species not originally included in them.

Alca Linn. 1758, would become *Pinguinus* Bonn. 1790.
Plautus Brünn. 1772, would become *Alca* Linn.
Thalasseus Boie, 1822, would become *Hydroprogne* Kaup, 1829.
Actochelidon Kaup, 1829, would become *Thalasseus* Boie.
Egretta Forster, 1817, would become *Herodias* Boie, 1822.
Herodias of the Check-List would become *Leucophoyx* Sharpe, 1894.
Micropalama Baird, 1858, would become *Hemipalama* Bonap. 1828.
Catharista Vieill. 1816, would become a synonym of *Cathartes* Ill. 1811.
Catharista of current usage would require a new name.
Urubitinga Lafres. 1843, would become *Morphnus* Cuv. 1817.
Morphnus of current usage would require a new name.
Helinaia Aud. 1839, would become a synonym of *Helmitheros* Raf. 1819.
Helinaia of current usage would require a new name.

I do not attribute to the learned Nomenclature Commission of the International Zoölogical Congress the intention of making rule *g* of Article 30 superior to the rules which precede it, and which it is explicitly stated shall be applied "in the order of precedence," and thus enforce first type designations whether right or wrong, in contravention of fundamental rules of all previous official codes; the possibility of such a conception would not have occurred to me had it not been forced upon my attention by certain naturalists who have placed this construction upon rule *g*. The one method conserves present generic nomenclature, the other entails needless changes and confusion.

Concordance of Changes from the A. O. U. Check-List, as recognized in 1904.

Since the publication of the last supplement to the A. O. U. Check-List in July, 1904, nearly 40 changes in the generic and subgeneric names then recognized have been shown, through the labors of various investigators, chiefly members of the A. O. U. Nomenclature Committee, to be necessary, most of them through the discovery of earlier names than those adopted, or the non-pertinency, for various reasons, of others. Nearly all these changes have been previously published, and some of the new names have become more or less current. The following concordance is based on the present paper, and includes some changes not yet endorsed by the A. O. U. Committee, while some changes endorsed by the Committee, especially in respect to the Swainsonian genera discussed on preceding pages (pp. 29–31), are not included in the concordance. A number have been acted upon by the Committee tentatively, and are thus virtually still open cases. The order of arrangement is alphabetic; the Check-List names of 1904 are given in the first column, the names here adopted in the second, and the reason of the change in the third.

Check-List Names.	*Names here adopted.*	*Reason of the change.*
Ampelis.	**Bombycilla.**	Not pertinent
Ardetta.	**Ixobrychus.**	Priority.
Aythya	**Nyroca.**	"
Callothorus.	**Tangavius.**	"
Camptolaimus.	**Kamptorhynchus.**	"
Ceophloeus.	**Phlœotomus.**	Not pertinent.
Cœligena.	**Cyanolæma.**	Tautonomy.
Columbigallina.	**Columbina.**	Preoccupied
Contopus.	**Myiochanes.**	"
Conurus.	Conuropsis.	Type by subsequent designation.
Crymophilus.	**Phalaropus.**	Tautonomy.
Cyanecula.	**Cyanosylvia.**	Priority.
Cyanospiza.	Passerina.	Type by subsequent designation.
Cyclorrhynchus.	**Phaleris.**	Priority.
Tiaris.	**Euetheia.**	Not pertinent.
Fulmarus.	**Rhantistes.**	"
Galeoscoptes.	**Dumatella.**	Priority.
Gypagus.	Sarcorhamphus.	Type by subsequent designation.
Hylophilus.	**Pachysylvia.**	Preoccupied.
Iache.	**Cynanthus.**	Priority.
Megascops.	**Otus.**	"
Merganser.	**Mergus.**	Not pertinent
Mergus.	Mergellus.	Type by subsequent designation.
Merula.	**Planesticus.**	Preoccupied.
Mycteria.	**Jabiru.**	Not pertinent.

Check-List Names.	*Names here adopted.*	*Reason of the change.*
Olbiorchilus.	Nannus.	Priority.
Ornithion.	Camptostoma.	Not pertinent.
Parus.	Penthestes.	“ “
Passerina.	Plectrophenax.	Type by subsequent designation.
Pavoncella.	Machetes.	Priority.
Phaleris.	Alcella.	Not pertinent.
Phalaropus.	Lobipes.	Tautonomy.
Procellaria.	Thalassidroma.	Not pertinent.
Podiceps.	Tachybaptus.	“ “
Simorhynchus.	Æthia.	Priority.
Tantalus.	Mycteria.	“
Trochilus.	——	Type by subsequent designation.

Index to the Generic Names referred to in this paper.

The names of the genera and subgenera here adopted as tenable for North American birds are printed in plain type; those incidentally mentioned, either as synonyms or as extralimital, are in italic type. The A. O. U. Check-List genera and subgenera number 429 = 388 genera + 41 subgenera. The 126 synonyms and extralimital genera mentioned raise the whole number to 555, for each of which the manner of type determination is indicated.

By the use of abbreviations, placed after the names, the index shows at a glance the basis of the determination of their types, and also whether they were monotypic or polytypic when originally founded. Thus

m = monotypic.
o = type by original designation.
t = type by absolute tautonomy.
m, o = type by both monotypy and original designation.
m, t = type by both monotypy and absolute tautonomy.
m, o, t = type determinable by original designation and by tautonomy as well as by original designation.
ex.,= extralimital.

Acanthis, s, 28.
Acanthopneuste, s, 28.
Accipiter, t, 25.
Actitis, s, 29.
Actodromas, m, 14.
Actochelidon, m, **10**, **14**, 39, 43.
Æchmophorus, m, o, 15.
Ægialitis, s, 29.
Aëronautes, m, 15.
Æstrelata, s, 29.
Æthia, m, 15.
Agelaius, s, 29.
Aimophila, s, 29.
Aithurus, m, ex., 12, 40.
Aix, s, 29.
Ajaia, m, o, t, 15.
Alauda, s, 29.
Alca, s, **10**, 29, 43.
Alcedo, s, ex., 27.
Alcella, o, 15.
Alle, m, t, 15.
Amizilis, o, 26.
Ammodramus, s, 29.
Ammospiza, o, 31.
Ampelis, s, ex., **12**, 15, **31**.
Amphispiza, o, 13.
Anas, s, 31.
Ancylocheilus, m, 18.
Anhinga, m, t, 15.
Anous, s, **10**, 31.
Anser, t, 26.
Antenor, m, 22.
Anthracothorax, ex., 31.
Anthus, s, 32.
Antrostomus, s, 32.
Aphelocoma, s, 32.
Aphriza, m, 15.
Aquila, t, 26.

Aramus, m, 15.
Aratinga, s, ex., 34.
Archibuteo, m, 15.
Arctonetta, m, 15.
Ardea, s, 32.
Ardetta, o, 36.
Arenaria, m, t, 15.
Aristonetta, m, o, 15.
Arquatella, m, 15.
Arremonops, m, o, 15.
Asarcia, m, 15.
Asio, t, 26.
Astragalinus, s, 32.
Astur, s, 32.
Asturina, m, 15.
Asyndesmus, m, o, 15.
Athene, s, 35.
Atthis, s, 32.
Auriparus, m, o, 15.
Aythia, s, 27.

Bæolophus, m, 15.
Bartramia, m, t, 15.
Basileuterus, m, 15.
Basilinna, s, 32.
Bernicla, t, 26.
Bombycilla, m, 15.
Bonasa, s, 32.
Boschas, t, 31.
Botaurus, s, 32.
Brachyramphus, s, 32.
Branta, s, 32.
Brewsteria, m, o, 15.
Bubo, t, 26.
Budytes, s, 15.
Bulweria, m, t, 15.
Burrica, o, 13.
Buteo, t, 26.
Buteola, m, 16.
Butorides, m, 16.

Calamospiza, m, 16.
Calcarius, m, 16.
Calidris, m, t, 16.
Callichelidon, o, 13.
Callipepla, m, 16.
Callothrus, m, 24.
Calothorax, m, o, 16.
Calypte, s, 32.
Campephilus, m, o, 16.
Camptolaimus, m, 20.
Camptostoma, m, o, 16.
Canace, m, 13.
Canachites, o, 13.
Canutus, t, 40.
Cardellina, m, 16.
Cardinalis, t, 26.
Carduelis, t, 26.
Carpodacus, s, 32.
Casarca, m, 16.
Catharista, s, 11, **32**, 43.
Cathartes, s, 11, **32**, 43.
Catherpes, m, o, 16.
Catoptrophorus, m, 16.
Centrocercus, o, 13.
Centronyx, m, 16.
Centurus, m, o, 16.
Ceophlœus, o, ex., 14.
Cepphus, m, 16.
Cerchneis, m, 16.
Cerorhincha, m, 16.
Certhia, s, 32.
Ceryle, s, 32.
Chæmapelia, s, 33.
Chætura, s, 32.
Chamæa, m, 16.
Chamæthlypis, o, 14.
Charadrius, s, 33.
Charitonetta, m, o, 16.
Charitospiza, o, 30.
Chaulelasmus, m, 16.
Chelidonaria, m, o, 16.
Chen, m, 16.
Chloroceryle, s, 33.
Chondestes, m, 16.
Chordeiles, m, o, 16.
Circe, m, 34.
Ciceronia, m, o, 16.
Cinclus, m, 17.
Circus, s, 33.
Cistothorus, s, 33.
Clangula, t, 26.
Clivicola, m, 24.
Coccyzus, m, 17.
Cœligena, t, ex., 17, 27.
Cœreba, m, 17.
Colaptes, s, 33.
Colinus, m, 17.
Columba, s, 33.
Columbigallina, m, 33.
Columbina, s, 33.
Colymbus. s, 38.
Compsohalieus, m, o, 17.
Compsothlypis, s, 33.
Contopus, m, o, 21.
Conuropsis, m, o, 17.
Conurus, s, ex., 17, 33.
Corvus, s, 34.
Cotile, m, 14.
Coturnicops, m, 17.
Coturniculus, s. 34.
Creagrus, m, o, 17.
Creciscus, m, o, 17.
Crex, m, t, 17.
Crotophaga, m, 17.
Crymophilus, m, 27.
Cryptoglaux, o, 14.
Cuclicivora, s, 38.
Curvirostra, t, 36.
Cuculus, s, 34.
Cyanecula, t, 17.
Cyanocephalus, m, t, 17.
Cyanocitta, o, 14.
Cyanolæma, m, o, 17.
Cyanospiza, o, 37.
Cyanosylvia, m, 17.
Cyclorrhynchus, m, 37.
Cymochorea, m, 14.
Cynanthus, s, 34.
Cypseloides, s, 34.
Cyrtonyx, s, 34.
Cyrtopelicanus, m, o, 17.

Dafila, m, o, 17.
Daption, o, 14.
Dendragopus, m, o, 14.
Dendrocygna, s, 34.
Dendroica, m, o, 17.
Dendronessa, o, 29.
Dendrornis, ex., 31.
Densirostra, m, 18.
Dichromanassa, m, o, 17.
Diomedea, s, 34.
Dolichonyx, m, o, 17.
Dryobates, m, 10, 18.
Dumatella, m, 17.
Dysporus, s, 34.

Dytes, m, 18.

Ectopistes, s, 34.
Egretta, m, 11, **18**, 43.
Elanoides, m, 18.
Elanus, m, 18.
Empidonax, m, 18.
Endomychura, o, 14.
Eniconetta, m, 23.
Ereunetes, m, 18.
Ergaticus, m, o, 18.
Erionetta, m, o, 18.
Erismatura, m, 18.
Erolia, m, 18.
Erythrina, t, 32.
Eudromias, m, 18.
Euetheia, m, o, **18**, 30.
Eugenes, m, 18.
Euphagus, m, 18.
Euphonia, s, 34.
Eurynorhynchus, m, 18.
Euspiza, o, 39.
Exanthemops, m, 18.

Falco, s, 34.
Florida, m, 18.
Francolinus, t, ex., 26.
Fratercula, m, t, 18.
Fregata, m, 18.
Fregetta, o, 14.
Fulica, s, 34.
Fuligula, t, 26, 27.
Fulmarus, s, ex., 11, **23**, 34.

Galeoscoptes, s, 18.
Gallinago, t, 27.
Gallinula, t, 27.
Gallopavo, t, 36.
Garzetta, t, 11.
Gavia, s, 22, **35**.
Gelochelidon, m, 19.
Geococcyx, m, 19.
Geothlypis, o, 35.
Geotrygon, s, 35.
Glaucidium, s, 35.
Glaucionetta, o, 14, 27.
Glottis, t, 27.
Grus, s, 35.

Guara, m, o, 19.
Guarouba, t, ex., 34.
Guiraca, s, 35.
Gymnogyps, m, 19.
Gypagus, s, 35, 38.

Habia, m, 25.
Hæmatopus, m, 19.
Haliæetus, m, 19.
Haliplana, m, 21.
Halocyptena, m, o, 19.
Harelda, m, 19.
Harpes, m, 19.
Harporhynchus, m, 19.
Harpyia, m, 25.
Heleodytes, s, 35.
Helinaia, s, **35**, 43.
Helminthophaga, s, 35.
Helminthophila, s, 30, **35**.
Helmitheros, m, 19.
Helodromas, m, 19.
Hemipalama, s, 43.
Herodias, s, 11, **35**, 43.
Hesperiphona, m, o, 19.
Heteractitis, m, 19.
Heterocelus, m, 19.
Hierofalco, m, 19.
Himantopus, t, 27.
Hirundo, s, 35.
Histrionicus, t, 19.
Hœrataria, m, ex., 26.
Horizopus, o, 21.
Hortulanus, 23.
Houppifere, m, ex., 26.
Hydranassa, m, 14.
Hydrochelidon, s, 10, **36**.
Hydroprogne, 43.
Hylatomus, m, 22.
Hylobrontes, o, 32.
Hylocichla, o, 14.
Hylophilus, s, 22.

Iache, o, 34.
Icteria, m, 19.
Icterus, t, 27.
Ictinia, m, 19.
Ionornis, m, o, 19.
Iridoprogne, o, 14.
Ispida, t, ex., 27.

Ixobrychus, s, 36.
Ixoreus, m, o, 19.

Jabiru, m, o, 19.
Jacamerops, m, ex., 26.
Jacana, t, 27.
Junco, m, 19.

Kamplorhynchus, m, 20.

Lagopus, t, 27.
Lampornis, s, ex., 31.
Lampronetta, m, 15.
Lanius, s, 36.
Lanivireo, o, 14.
Larus, s, 36.
Leptopelicanus, m, o, 20.
Loptotila, m, 20.
Leucophoyx, m, 43.
Leucosticte, m, o, 20.
Limosa, t, 27.
Lobipes, m, 20.
Lophodytes, m, o, 20.
Lophortyx, s, 36.
Loxia, s, 36.
Lunda, s, 36.

Machetes, m, 20.
Macronectes, m, 20.
Macrorhamphus, m, 20.
Mareca, s, 36.
Marila, t, 26.
Megalestris, m, 20.
Megalopterus, m, 10.
Megaquiscula, s, 36.
Megascops, m, 22.
Melanerpes, m, o, 20.
Melanitta, s, 36.
Meleagris, s, 36.
Melopelia, s, 36.
Melospiza, o, 14.
Merganser, s, 36.
Mergellus, m, 20.
Mergus, s, 36.
Merula, t, 38.
Micrathene, m, o, 20.
Micrura, o, 14.
Micropalama, m, o, **20**, 43.
Micropallas, m, o, 20.

Mimetes, m, 20.
Mimus, m, 20.
Mniotilta, m, 20.
Molothrus, m, o, 20.
Morphnus, s, ex., 43.
Motacilla, s, 36.
Muscivora, o, 14.
Myadestes, m, 20.
Mycteria, m, 20.
Myiarchus, s, 37.
Myioborus, o, 14.
Myiochanes, m, 21.
Myiozetetes, o, 14.

Nannus, m, 21.
Neocorys, m, t, 21.
Netta, m, 21.
Nettion, m, 21.
Noctua, m, 35.
Nomonyx, m, o, 21.
Nucifraga, m, t, 21.
Numenius, t, 27.
Nuttallornis, m, o, 21.
Nyctala, m, 14.
Nyctanassa, m, o, 21.
Nyctea, t, 27.
Nycticorax, t, 27.
Nyctidromus, m, 21.
Nyroca, t, 27.

Oceanites, m, 21.
Oceanodroma, m, o, 21.
Ochthodromus, m, o, 21.
Œnops, s, 32.
Oidemia, s, 37.
Olbiorchilus, o, 21.
Olor, s, 37.
Onychoprion, m, 21.
Oporornis, s, 37.
Oreopyra, m, ex., 31.
Oreortyx, m, o, 21.
Oreospiza, m, o, 21.
Ornithion, m, ex., 16, 22.
Oroscoptes, m, 22.
Orpheus, m, 20.
Ortalis, s, 37.
Ossifraga, m, 20, 35.
Otogyps, m, o, ex., 11.
Otocoris, m, 22.
Otus, m, 22.
Oxyechus, m, o, 22.

Pachysylvia, m, 22.
Pagophila, m, 22.
Pallasicarbo, m, o, 22.
Pandion, m, 22.
Parabuteo, m, o, 22.
Parus, s, 37.
Passer, t, 27.
Passerculus, s, 37.
Passerella, m, 22.
Passerherbulus, m, o, 31.
Passerina, s, 37.
Pastor, ex., 38.
Pavoncella, m, 20.
Pediœcetes, m, o, 22.
Pelagodroma, m, o, 22.
Pelecanus, s, 37.
Pelidna, s, 37.
Pelionetta, m, 22.
Pendulinus, s, 37.
Penthestes, m, o, 22.
Perisoreus, s, 37.
Petrochelidon, s, 37.
Peucæa, s, 37.
Peucedramus, m, o, 22.
Phaëthon, s, 37.
Phainopepla, m, o, 22.
Phalacrocorax, t, 27.
Phalænoptilus, m, o, 22.
Phalaropus, t, 27.
Phaleris, s, 37.
Philacte, m, 22.
Philohela, m, o, 22.
Phlœotomus, m, o, 22.
Phœbastria, m, o, 22.
Phœbetria, m, o, 22.
Phœnicopterus, m, 23.
Pica, t, 28.
Picicorvus, m, 23.
Picoides, m, s, 37.
Pinguinus, s, 43.
Pinicola, m, 23.
Pipilo, m, 23.
Piranga, m, 23.
Pitangus, m, 23.
Planesticus, s, 37.
Platypsaris, o, 14.
Plautus, m, 10, **23**, 43.
Plectrophenax, m, o, 23.
Plegadis, m, 23.
Plotus, m, 15.
Podasocys, m, o, 23.
Podiceps, s, 24.
Podilymbus, m, 23.
Polioptila, s, 38.
Polyborus, m, 23.
Polysticta, m, 23.
Poœcetes, m, 23.
Porzana, m, t, 23.
Priocella, m, 23.
Priofinus, s, 38.
Procellaria, s, ex., **11**, 25, 38.
Progne, m, 23.
Protonotaria, m, t, 23.
Psaltriparus, m, 23.
Psittacara, o, ex., 33, 34.
Ptychoramphus, m, 23.
Puffinus, t, 28.
Pyrgita, s, 27.
Pyrocephalus, s, 38.
Pyrrhula, t, 28.
Pyrrhuloxia, m, 23.
Pyrrhura, m, ex., 33, 34.

Querquedula, t, 26, 28.
Quiscalus, t, 28.

Rallus, s, 38.
Recurvirostra, m, 23.
Regulus, m, t, 23.
Rhantistes, m, 23, 35.
Rhinogrhyphus, o, 32.
Rhodostethia, m, o, 24.
Rhyacophilus, s, 38.
Rhynchodon, s, 38.
Rhynchofalco, m, o, 24.
Rhynchophanes, m, 24.
Rhynchopsitta, m, 24.
Riparia, m, t, 24.
Rissa, m, o, t, 24.
Rostrhamus, m, 24.
Rusticola, t, 38.

Salpinctes, s, 38.
Sarcorhamphus, s, **11**, 38.

Sayornis, m, or s, 24.
Saxicola, s, 38.
Scardafella, s, 38.
Scolecophagus, m, 18.
Scolopax, s, 38.
Scops, m, t, 22.
Scotiaptex, s, 39.
Seiurus, s, 39.
Selasphorus, s, 39.
Setophaga, s, 39.
Sialia, s, 39.
Simorhynchus, s, 15.
Sitta, m, 24.
Somateria, m, 24.
Spatula, m, 24.
Speotyto, m, 24.
Spermophila, s, 39.
Spinus, t, 28.
Spiza, s, 39.
Spizella, m, 24.
Spodesilaura, m, 18.
Sporophila, s, 39.
Sphyrapicus, o, 14.
Squatarola, t, 28.
Starnœnas, m, 24.
Steganopus, m, 24.
Stelgidopteryx, m, o, 24.
Stelleria, m, 23.
Stellula, m, 24.
Stercorarius, t, 28.
Sternula, m, 24.
Streptoceryle, s, 39.
Strix, s, 39.
Sturnella, m, 24.
Sturnus, s, 39.
Sula, t, 28.
Surnia, m, 24.
Sylochelidon, m, 10.
Symphemia, m, 18.
Synthlyborhamphus, s,39.
Syrichtha, m, 21.
Syrnium, m, 24.

Tachybaptus, m, o, 24.
Tachycineta, s, 39.
Tachytriorchis, m, 24.
Tadorna, t, ex., 26.
Tangavius, m, 24.
Tantalus, m, **20**, 25.
Tetrao, t, ex., 28.
Thalassarche, m, o, 25.
Thalasseus, s, 10, **39**, 43.
Thalassidroma, o, 11, 25.
Thalassœca, m, o, **35**.
Thalassogeron, m, o, 25.
Thrassaëtos, m, 25.
Thryomanes, m, 25.
Thryothorus, m, 25.
Tiaris, s, ex., 30, 40.
Tinnunculus, s, 40.
Torda, m, 10, 23.
Totanus, t, 28.
Toxostoma, m, 25.
Trichas, t, 35.
Tringa, s, 40.
Trochilus, s, ex., **12**, 40.
Troglodites, m, 21, 40.
Troglodytes, s, 40.
Trogon, m, 25.
Tryngytes, m, 25.
Turdus, s, 40.
Tympanuchus, m, 25.
Tyrannus, t, 28.
Uranomitra, s, 40.
Uria, t, 28.
Urile, t, 28.
Urinator, s, 35.
Urogallus, t, 28.
Urubitinga, m, t, **25**, 43.
Vanellus, t, 28.
Vermivora, s, t, 19, 29, 30, 40.
Vestiaria, m, ex., 26.
Viralva, s, **36**.
Vireo, s, 40.
Vireosylvia, s, 40.
Vultur, s, ex., 11.
Wagellus, o, 11.
Wilsonia, s, 40.

Xanthocephalus, m, t, 25.
Xanthoura, s, 40.
Xema, m, 25.
Xenopicus, m, 25.
Xipholena, m, 12.
Xiphorhynchus, o, ex., 31.
Xiphornis, o, 31.

Yphantes, s, 40.

Zamelodia, o, 25.
Zenaida, t, 28.
Zenaidura, m, 25.
Zonotrichia, s, 40.

ADDENDUM.

In the preceding list of 'Monotypic Genera' (*antea*, pp. 14–25), to all of Reichenbach's genera should have been added: "Also type by original designation," omitted by oversight. They are properly designated, however, in the index by the affixed abbreviations *m*, *o*. The record may be here completed, as follows:

Add after *Ajaia*, p. 15. Also by original designation.
" " *Ciceronia*, p. 16. " " "
" " *Cyrtopelicanus*, p. 17. " " "
" " *Euetheia*, p. 18. " " "
" " *Guara*, p. 19. " " "

Add after *Ionornis*, 19. Also by original designation.
" " *Leptopelicanus*, p. 20. " " "
" " *Lophodytes*, p. 20. " " "
" " *Oceanodroma*, p. 21. " " "
" " *Ochthodromus*, p. 21. " " "
" " *Oxyechus*, p. 22. " " "
" " *Pelagodroma*, p. 22. " " "
" " *Penthestes*, p. 22. " " "
" " *Phœbastria*, p. 22. " " "
" " *Phœbetria*, p. 22. " " "
" " *Tachybaptus*, p. 24. " " "

ERRATA.

Page 17, last line of text, for **Dumatella** read **Dumetella**.
" 32, line 27, for *Loxia erythrina* Linn., by designation of Gray in 1855, read *Fringilla rosea* Pall., by designation of Gray in 1842.
" 33, " 7, for Gray in 1840 read Gray in 1855.
" 37, " 30, for Gray in 1855, read Gray in 1841.
" 38, " 12, for Gray in 1840, read Gray in 1841.
" 38, " 19, for Gray in 1855, read Gray in 1842.
" 40, " 19, for Oberholser in 1902 read A. O. U. Nomenclature Committee in 1886.

Article II.— NOTES AND OBSERVATIONS ON CARBONIFEROUS FOSSILS AND SEMIFOSSIL SHELLS, BROUGHT HOME BY MEMBERS OF THE PEARY EXPEDITION OF 1905–1906.

By R. P. Whitfield.

Plates I–IV.

Near the end of May, 1907, the Museum received a small collection of limestone fossils from G. A. Wardwell of the last Peary Expedition, said to have been collected at Cape Sheridan, Latitude 82° 27′ north. On close examination they proved to be of Coal Measure types and all Brachiopods, consisting of species of *Spirifer*, *Productus*, *Orthothetes* (= *Streptorhynchus* King), *Syringothyris*, and a new genus *Arctitreta*, in all five genera, no forms but Brachiopods being represented.

On working out these fossils from the rock, I find them all representatives of forms that have been recognized by previous investigators of collections brought from the same region, with the exception of the unarticulated genus *Arctitreta*, and in looking over the various works accessible to me I find none closely allied to these except the forms figured in the Journal of the Royal Dublin Society for February, 1857. In tracing these into later publications, I find in the Quarterly Journal of the Geological Society of London, Vol. XXXIV, 1878, the article by R. E. Etheridge on the Palæontology of the coast visited by the Arctic Expedition under Capt. Sir George Nares, R. N., during the years 1875 and 1876. In that work, under the section Carboniferous, Class *Brachiopoda*, at p. 608, I find descriptions of many Carboniferous forms from the region of the Feilding Peninsula, a little northwest of Cape Sheridan, that are evidently from rocks that must be a continuation of the beds near Cape Sheridan, from which these specimens were obtained, though I have been informed by Mr. Wardwell that the slab from which these were obtained was not actually attached to the ledge when he collected them.

Taking into consideration the forms of Brachiopoda which are found among those sent to the Museum by the Peary Expedition, I will institute a comparison of my own views of the several species, with those expressed by Mr. Etheridge of each of the forms present. This I do because I cannot agree precisely with Mr. Etheridge's interpretations of their relationship with European species. The species represented in our collection, taking them collectively, I should consider as strictly Carboniferous, and eminently an expression of an American Coal Measure fauna, according to identification of the species as usually recognized in this country.

Streptorhynchus, Etheridge, Quart. Jour. Geol. Soc. Lond., Vol. XXXIV, p. 635, pl. xxix, fig. 4. There is an undoubted *Streptorhynchus* (*Orthothetes*) among our Cape Sheridan specimens which I have referred to *S. crenistria* King.

Spirifera aldrichi Etheridge, Quart. Jour. Geol. Soc. Lond., Vol. XXXIV, p. 634, pl. xxix, fig. 2. We have a single dorsal valve resembling the figure given as above, only that it differs in dimensions. It is mostly an internal cast, the shell having been left on the rock from which the slab came before it was collected; it measured from the center to the extremity a little more than one and one eighth inches. Therefore it must have been over two inches and a quarter in its original state, while from beak to front it but slightly exceeds an inch; the mesial fold is simple and very broad in front; the plications are about nine on each side, possibly ten. They are also simple and show but little angularity; they present no surface sculpture, the shell being entirely gone. From its general form and proportions I have associated it with the *Syringothyris* herein described, and see no reason for changing the reference, and it is mentioned in my remarks under that species as such.

Spirifer sp. (allied to *S. granulifera* Hall) Etheridge, Quart. Jour. Geol. Soc. Lond., Vol. XXXIV, p. 634. (See pl. xxix, fig. 3, referred to on p. 636 *loc. cit.*)

The dorsal valve which I have referred to *Syringothyris* under my remarks on *Spirifer aldrichi* is most nearly allied in form and general features to *S. granulifera* Hall, of any of those we have from Cape Sheridan. But the figure given on pl. xxix, in Mr. Etheridge's article, is so remarkably unlike *S. granulifera* Hall as to need no comparison.

Spirifer sp., allied to *S. grimesi* Hall, Geol. Iowa, Vol. I, pt. 2, p. 604, t. 14, figs. 1–5. (Pl. xxv., fig. 5, Quart. Jour. Geol. Soc., Vol. XXXIV.) We have a single internal cast of a dorsal valve which probably represents the specimen he figures. It differs, however, from *S. grimesi* Hall, in not having distinct plications, only being finely striate, even more finely than the *Streptorhynchus* sp., pl. xxix, fig. 4, of his article but it presents the muscular scar of *Spirifer*, dorsal side, while the figure in the Quarterly Journal represents that of the ventral valve.

Spirifera cristata Schlot, var. *S. octoplicata* (Sow.) Etheridge. There is nothing in our collection that can be identified with this form nor with the species as figured in Davidson's Monograph as referred to by Mr. Etheridge. There are two or three young Spiriferoids present in the collection, but when closely examined they prove to be either the young of *Syringothyris* or of *Spirifer cameratus.*

The species referred to under this heading I have identified with the genus *Syringothyris* Winchell. Among our specimens we have several individuals of different sizes, from three fourths of an inch to two inches in transverse diameter measured on the hinge line. It has the same lamellose or zigzag structure of the plication and a very high vertical cardinal area, a large broad deltidial foramen, simple plication and simple fold, with a deep broad sinus on the ventral side. The valves are long transversely with only about half the length from hinge to front. Our largest ventral valve is much mutilated, the surface shell being pretty much denuded, and the apex of the valve crushed, but the substance of the shell on the cardinal area is about half retained. The apex indicates the internal tube characteristic of the genus *Syringothyris,* as well as the general form of the valves.

The largest dorsal valve represents a shell about two inches broad, with a length, from beak to front, of one inch and an eighth, having had a perfectly vertical cardinal area. It shows a mesial fold, simple, rapidly widening forward, and rather highly elevated, with about eight or nine simple plications on each side. On a smaller individual where the shell is partially preserved, the plications are more angular and rugose, resembling those of *Spiriferina.*

As this Arctic species cannot possibly be the same as McCoy's *Cyrtina lamellosa* or *laminosa,* nor yet Davidson's *Spirifer laminosa,* I shall venture to designate it as **Syringothyris arctica**, new species.

Spirifer duplicicosta Phill. We have no form comparable to Phillip's species, and nothing that will compare with the figures given in Davidson's Monograph referred to by Mr. Etheridge. He remarks, however, that one specimen of the lot resembles *Spirifer striatus* Martin, which he says is a closely allied form. He also refers to *S. fasciger* Kesserling, which he considers the same as the British species and those from the Feilden Isthmus, with the remark, "that one specimen resembles *S. striatus.*" I shall have something further to say later in this paper on this subject.

Spirifer allied to *S. pennatus* (Owen) Etheridge, Quart. Jour. Geol. Soc. Lond., Vol. 34, p. 633, pl. xxix, fig. 1. I have seen nothing among these Cape Sheridan specimens resembling this form.

Under the head of *Spirifer duplicicosta* Mr. Etheridge states that one of his specimens resembles *S. striata* Martin. We have a number of ventral valves and three dorsal valves, all more or less imperfect, which might without careful study and comparison be thought to represent *S. striata,* but when closely examined they invariably show the striæ — or rather plications, for such they really are — to be grouped more or less distinctly into fascicles, and by this one feature differ radically from all the various forms of the *S. striata* type known in the American Lower Carboniferous or Coal Measure rocks, and intimately ally them with our American widely distributed and characteristic Coal Measure *Spirifer camaratus* Morton; in fact one of the dorsal valves, partially hidden under a group of *Productus*, is as well marked and characteristic a *Spirifer cameratus* as any specimen in our extensive Coal Measure collection. Besides these features, the species is usually laterally extended on the hinge line, while *S. duplicicosta* has generally rounded cardinal angles, a feature which distinctly separates the two forms. Still both of them, judging from Davidson's statement in his Monograph, are apt to show both varieties. And his figures given on Plate II (figures 13 and 13*a*), of Part V, Carboniferous Brachiopoda, referred to *S. attenuata* Sowerby, copied from the figures in Mineral Conchology, Vol. V, plate 493, quite resembles *S. cameratus* on one side.

Spirifer lineatus Martin. (Comp. *S. pseudolineatus* Hall, Geol. Rep. Iowa, 1858, p. 645; pl. 20, fig. 4.) Some six or eight valves of *Spirifer lineatus* of various sizes are present among these Cape Sheridan specimens, the largest among them being one and a quarter inches in transverse diameter, and a ventral valve. As most of them seem to be dorsal valves, they were at first looked upon as *Athyris*, probably *A. royssi* L. Eveille. But a single specimen had a sharper beak, and was apparently without perforation. I succeeded after considerable labor in uncovering the entire beak and in obtaining the hinge line and dentidial fissure so as to make it positively *Spirifer lineatus*.[1] The specimens usually show the concentric lining and some of the punctæ for the attachment of the setæ which characterize both of these species. All of these valves but one are of the usual nearly circular form, but the one exception is a dorsal valve denuded of shell and having a transverse diameter about as three to two of the length from beak to front. Another valve, a ventral, also denuded of shell, has about the normal proportions of length and breadth but had a plainly defined mesial furrow and shows the usual elongate lanceolate muscular scar.

Productus semireticulatus (Martin) Etheridge, Quart. Jour. Geol. Soc., Vol. XXIV, 1878, p. 629. We have a number of specimens of *Productus* that might be referred to this species were it not for many remarkable discrepancies in their characters as compared with those of that species as found both in Europe and America. In the first place the northern shell is more deeply sulcated on the ventral valve than is usual on *P. semireticulatus*. In this respect it more resembles *P. horridus* of the Permian, but this is always distinctly marked with linear ribs or lines, and does not possess the cardinal spines so prevalent on that species. The Arctic shell is always narrowed or compressed on the sides of the beaks behind, while in *P. semireticulatus* the beak is broad and short with a hinge line as wide as any part of the shell, while here it is commonly contracted, and on the exterior the ventral valve is but faintly marked by the concentric lines which is so characteristic in *P. semireticulatus*. On the interior of this northern shell the disc of the inner valve is very flat and the geniculations sharp and abrupt, while the cavity of the ventral is deep and much more strongly sulcated than the exterior. Aside from all these discrepancies, when the shell is viewed in profile it is seen to be more strongly curved or geniculate than almost any other referred to that extremely variable species. If it is to be referred to it at all I would suggest it to be coupled with the term *arctica*, as *Productus semireticulatus* **arctica**.

---

[1] The only other American species which this closely resembles is the one in the Keokuk limestone which Hall described as *S. pseudolineatus*, but which is much larger and broader, with a distinct mesial fold which this species seldom or never possesses.

Productus mesolobus (Phill.) Etheridge, Quart. Jour. Geol. Soc. Lond., Vol. XXXIV, p. 620; Phil. Geol. Yorkshire, Vol. II, p. 215, t. 7. figs. 12 and 13. Not *P. mesolobus* as figured from Russia and Ural Mountains.

There is nothing in the Cape Sheridan collection corresponding with these references, nor with *P. fimbriatus*.

Productus costatus Sow., Min. Conch., Vol. VI, pl. 560, fig. 1; — Davidson, Monog., t. 32, fig. 2–9.

None of our specimens will match any of these references. All of the Cape Sheridan specimens have a remarkably narrowed beak, and are usually very deeply sulcated along the central line but more especially so in the interior. They are also remarkably free from spines or spine bases and have even regular lines and are nearly destitute of concentric undulations on the disc or on the beak portions.

Productus weyprechti? (Toula) Etheridge, Quart. Jour. Geol. Soc. Lond., Vol. XXXIV, p. 631.

Productus sulcatus var. *borealis* Houghton, Jour. Royal Dublin Soc., Feb. 1857, p. 60, pl. 7, figs. 1 and 7.

I should doubt the identity of any of these Cape Sheridan species of *Productus* being equivalent to Toula's species *P. weyprechti* as quoted by Mr. Etheridge, and should much prefer to go back to Houghton's name *P. sulcatus* var. *borealis*, or, owing to the use of the name *P. sulcatus* as a synonym of *costatus* by Mr. Davidson and others, I should prefer to call it simply *Productus borealis* Houghton.

Productus verneuilianus De Koninck, Recherches sur les Animal Foss., Productus and Chonetes, p. 163, pl. xviii, fig. 6.

De Koninck, in the above quoted work, gives a species of *Productus* under the above specific name. It is, however, so insignificant in size that it seems improper to refer to it as a name for a moderately sized shell.

There are, however, two specimens of *Productus* among these Cape Sheridan fossils, one of which must have been fully an inch wide on the hinge when entire and the others about three fourths of an inch, that are so nearly like the enlarged figures given by De Koninck under the above specific designation that it seems discourteous not to refer to them. The two specimens are given natural size on the plate, with the name appended as a suggestion, and future collections may or may not confirm the reference.

Productus longispinus Sow. var. *wabashensis*, N. & P. A single individual of the species, and of the var. *wabashensis*, is present in the collection. It so distinctly and unmistakably belongs to this species and variety that no one could mistake it. The specimen is without striæ and without spines. In size, form and shape it so exactly resembles those from the Coal Measures of the United States of America that it looked like an old friend when I first saw it, and it caused me to wonder how so small an individual had rambled so far from home, for it seems to be entirely alone, no vestige of another having been detected. This single individual is perhaps a little longer from beak to front than the normal form. The *P. verneuilianus* De Koninck, above commented on, looks much like an overgrown specimen of this species, but besides being much larger than this, it is decidedly more angular, flatter, with a broader and deeper mesial depression.

Beyond the species discussed in the above pages, there are the evidences of three distinct species of *Rhynchonelloides* that are undeterminable as to species. One of them is a finely plicated shell resembling *Camarotechia*, with highly elevated fold. The others are more like *Camarophoria*, but all so imperfect as to be beyond identification without other and more perfect material.

Among these Carboniferous forms I find one species that has puzzled me greatly, as it mimics so exactly a form characterizing earlier periods. For some time I could scarcely conceive of a form so closely resembling a Silurian genus so extremely rare as *Siphonotreta*, associated with several such eminently Coal Measure species as *Streptorhynchus crinistriata*, *Spirifer carmeratus*, *Reticularia lineata*, and a group of *Productus* so plainly characteristic of Coal Measure rocks.

For some time I delayed considering it as strictly belonging to the series, as the specimens were all imperfect, and all apparently ventral valves, which, owing to their apparent distortion, I concluded were only distorted *Streptorhynchus* with highly imperfect cardinal areas. Until near the end of my studies of the Cape Sheridan series I had wished to get a figure of the *Productus*, and it became necessary to separate it from the block of a group which had been photographed. In doing this I broke off quite a fragment and it revealed the specimen depicted by figure 1 on Plate II. This at once showed the real nature of previously imperfect material and decided the claim to consideration as a member of the Cape Sheridan fauna.

The determination of the genus to which it can belong now is a question to be decided. It evidently belongs to Beecher's NEOTREMATA but will not fit into any of the established genera under that group, and I propose for it a new genus under the name of **Arctitreta**, with the following diagnosis.

Arctitreta,[1] new genus.

Unarticulated Brachiopodous shells, having depressed convex valves, the pedicel valve the larger with a flattened cardinal area divided in the middle by a triangular fissure provided with a convex deltidium; apex with a minute perforation. Muscular scar large, situated in the upper apical portion of the valve, flabeliform, bilateral, shell striated, fibrous under the microscope. Dorsal valve unknown.

Type, *Arctitreta pearyi* sp. nov. Coal Measure limestone in the Arctic Region.

Arctitreta pearyi n. sp.

PLATE II, FIGS. 1–4.

Shell of moderate size, the type specimen being just one inch in length on the dorsal valve, broadly ovate in outline, very depressed convex, the apical portion most convex and nearly flat toward the basal margin. Cardinal area moderately large, flat, divided by a narrow median fissure and generally covered by a slightly convex deltidium. Surface marked by sharp angular radiating striæ, strongly diverging toward the margins in the upper lateral portions. Interior surface of shell strongly striato-pustulose, more strongly so around the flabellate muscular scar.

Geological position and Locality.— In Carboniferous limestones bearing Coal Measure fossils, at Cape Sheridan, Grant Land, N. Am., latitude 82° 27′ north. Collected by Engineer J. A. Wardwell of the S. S. 'Roosevelt,' 1906.

In addition to the Carboniferous fossils, members of the Expedition brought a number of *Astarte borealis* and *Saxicava rugosa* obtained from several different stations, extending from Wrangle Bay and Lincoln Bay up to Cape Sheridan, and from raised beaches and banks ranging from twenty to one hundred and fifty feet above sea level and from near river banks to a distance of two miles inland. Some of the shells seem much like living or very recently dead shells, while others show considerable decay. The *Saxicava* are not more decayed looking than many of the Quarternary specimens, found at localities in Maine, on Lake Champlain, or near Quebec, Canada. The *Astarte* look very much like recently dead shells picked up on our own sea beaches. The *Astarte* is much larger than any of the many fossil species in our Miocene and later Tertiarics and as we had no specimens of *Astarte borealis,* I sent a few valves to Dr. W. H. Dall at Washington who informed me they were *A. borealis* Schum.

---

[1] *Arctos*, northern, and *tretos*, perforated.

It would seem probable, from the different elevations above sea level at which these various lots occur, that there has been considerable movement taking place in the elevation of the land within these regions within a comparatively short time, judging by the condition of the preservation of the shells. The specimens are listed at follows:

Lot No. 80. Wrangle Bay, June 8, 1906. *Astarte borealis.* Badly decayed. Found two hundred yards inland, at about twenty feet elevation.

Lot No. 81. Cape Sheridan, Lat. 82° 27′, June 28, 1906. Mostly *Saxicava rugosa.* Found one mile inland, and at seventy feet elevation above sea level. Picked up on the shore of a lake. These shells are mostly in fair condition and would hardly be considered as in semifossil condition. A few of them show weathering and decay.

Lot No. 82. Found 1½ miles inland, and at 150 feet elevation, Lat. 80° 30′. *Astarte borealis,* some of which show decay and others preserve considerable epidermis. Some shells in this lot are of heavier build with higher beaks, resembling in aspect *Astarte lens* Stims. from the Quarternary beds at Woodfords Corners, Deering, Maine, presented to the museum by Dr. A. Parsons of Portland, Me.

Lot. No. 83. Shells dug from side of river bank, eight feet from (below?) the surface and twenty feet above sea level, by G. A. Wardwell. Cape Sheridan, Lat. 82° 27′, May 28, 1906. *Astarte borealis.* Most of the valves preserve more or less of the epidermis.

Lot No. 84. Lat. 83°, June 9, 1906. *Astarte borealis* and *Saxicava rugosa*, found ¾ mile inland, at 35 feet elevation, 25 feet above the river bed, by G. A. Wardwell. Rather poorly preserved.

Lot No. 85. Principally *Saxicava rugosa.* Found ¾ of a mile inland and at 60 feet elevation. Lat. 82° 27′.

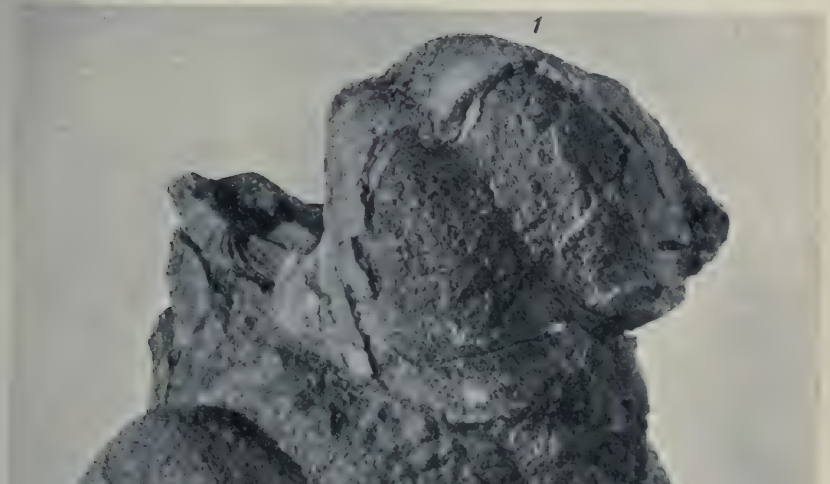
Lot. No. 86. Lincoln Bay, Sept. 1, 1905, collected by Charles Percy, Sr. Two miles inland, at 100 feet elevation, Lat. 82° 16′. *Astarte borealis,* some of very large size and smooth, a few with epidermis well preserved. Some of them have the smooth silky black epidermis so perfectly preserved, that it would seem they could not have been out of the water any great length of time. A number of them are of exceedingly large size, and many are badly decayed.

EXPLANATION OF PLATE I.

The figure on this Plate is from a photograph of a group of the Cape Sheridan fossils that has been cleared out from the limestone to show more clearly the different species associated in the limestone. The group was afterward dismembered in order to reveal more clearly some of the specimens. This group is given principally to show the specimen (fig. 1) of *Productus borealis* Houghton, which is equivalent to *P. weyprechti* (Toula) Etheridge, or *P. sulcatus* Sowerby.

EXPLANATION OF PLATE I.

The figure on this Plate is from a photograph of a group of the Cape Sheridan fossils that has been cleared out from the limestone to show more clearly the different species associated in the limestone. The group was afterward dismembered in order to reveal more clearly some of the specimens. This group is given principally to show the specimen (fig. 1) of *Productus borealis* Houghton, which is equivalent to *P. weyprechti* (Toula) Etheridge, or *P. sulcatus* Sowerby.



ARCTIC FOSSILS.

EXPLANATION OF PLATE II.

Arctitreta pearyi Whitfield.

Fig. 1. View, nat. size, of the best ventral valve, retaining the shell on the upper part of the valve.

Fig. 2. Enlargement to two diameters of an imperfect ventral valve, showing the short ridged striæ. The beak has been slightly chipped.

Fig. 3. Enlargement (2×) of the cardinal area and deltidium of another specimen.

Fig. 4. Enlargement (2×) of the cardinal area of the specimen, figure 2.

Productus wabashensis.

Fig. 5. View, nat. size, of the specimen which I have referred to this species, but which might properly be referred to as a young example of the following.

Productus verneuilianus.

Figs. 6 and 7. Views, nat. size, of two valves referred to this species.

Productus semireticulatus arcticus.

Fig. 8. View, nat. size, of the top of the shell seen at fig. 2, on the group given on Plate I. The beak is towards the observer to show its narrow elongated form in contrast to the short broad beak of *P. semireticulatus*, usually seen.

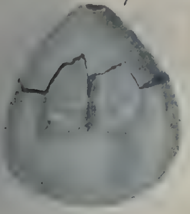
Fig. 9. Side view of the same specimen taken out from the group.

Fig. 10. Photographic view of another specimen to show the pustulate structure of the inside of the ventral valve and the great thickness of shell filling the mesial depression in the casts.

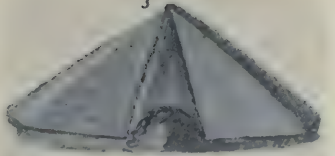
Productus borealis Houghton.

Fig. 11. View, nat. size, of a dorsal valve referred to this species showing remains of spines along the hinge, allying it to *Productus horridus*.

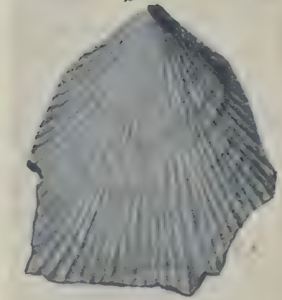
1



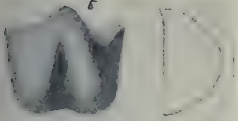
3



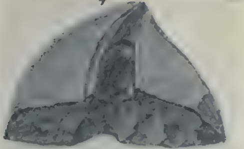
2



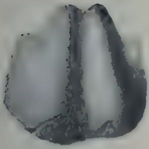
5



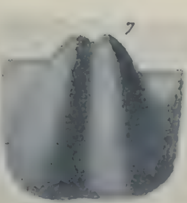
4



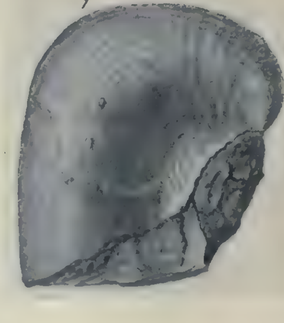
6

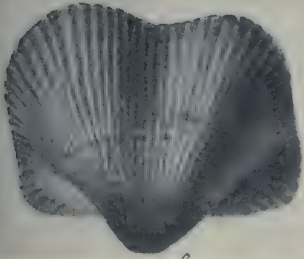


7



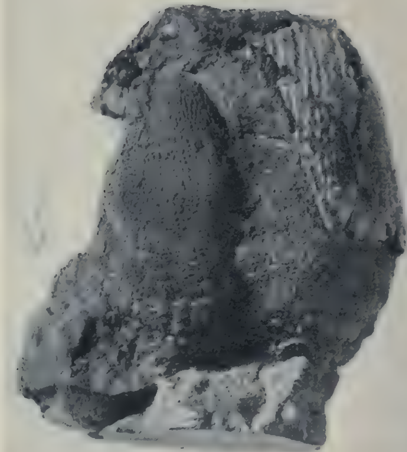
9



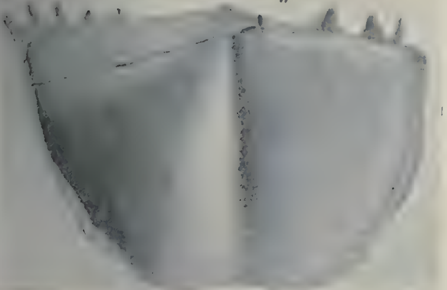


8

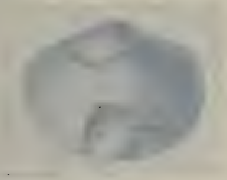
10

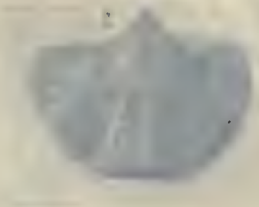


11



ARCTIC FOSSILS.





EXPLANATION OF PLATE III.

SPIRIFER (MARTINIA) LINEATA Martin.

Fig. 1. An imperfect dorsal valve, nat. size, mosty denuded of the shell.

Fig. 2. View of a ventral valve, retaining the shell in most parts. Nat. size.

SPIRIFER CAMERATUS Morton.

Fig. 3. View of a dorsal valve, nat. size, which underlies the imperfect *Productus* on the lower middle portion of the group figured on Plate I, but which cannot be seen in that figure.

Fig. 4. View of an imperfect ventral valve of this same species showing the usual fasciculate disposition of the striæ which distinguish it from *Spirifer striatus* Sowerby.

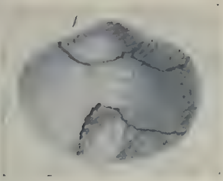
SYRINGOTHYRIS ARCTICA.

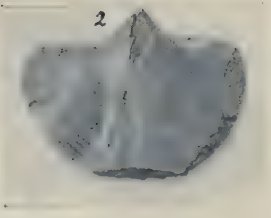
Fig. 5. View of a dorsal valve referred to this species, which is denuded of shell except along the hinge line.

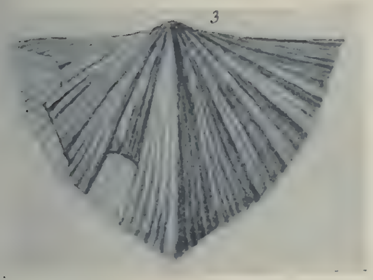
Fig. 6. A ventral valve with a little of the exfoliated shell retained, but the beak is broken away.

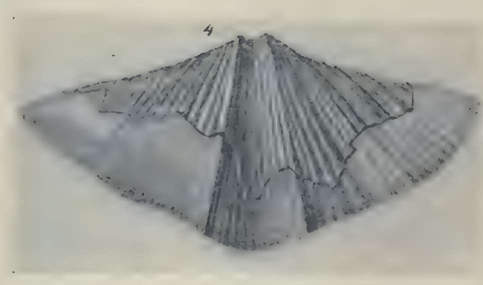
Fig. 7. View of the cardinal area of the same valve, nat. size.

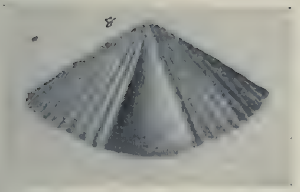
Fig. 8. A young ventral valve preserving the shell, which shows the zigzaging cross-lines described by Etheridge as a feature of *spiriferina*.

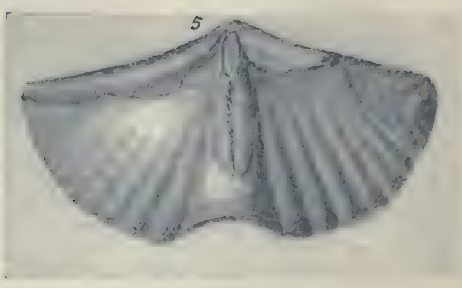

1

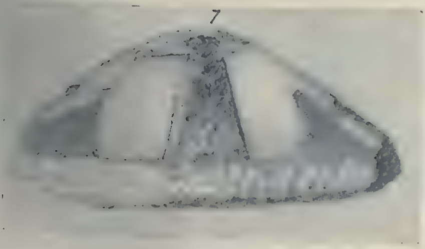

2

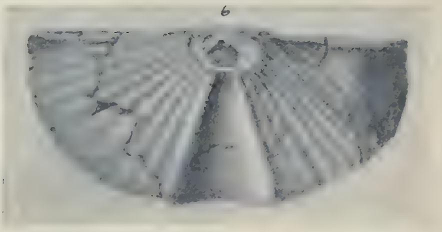

3


4


8


5


7


6

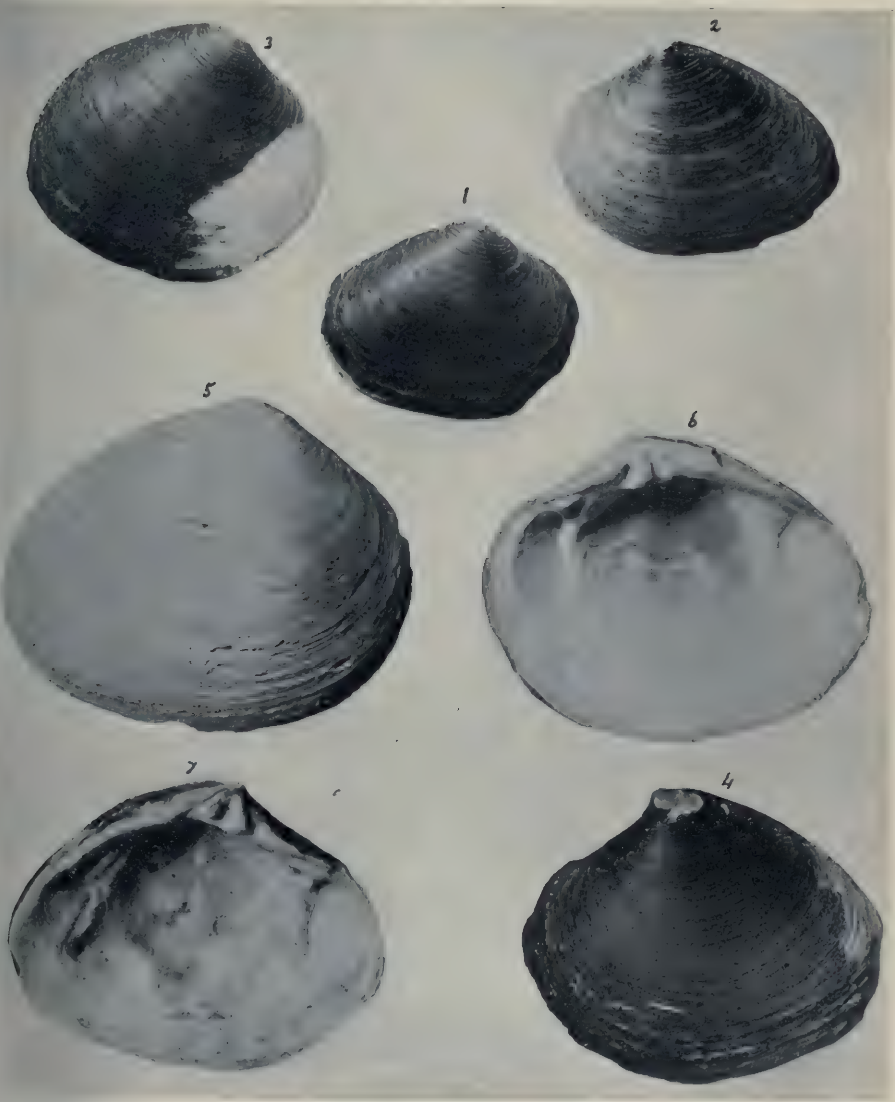
ARCTIC FOSSILS.

EXPLANATION OF PLATE IV.

ASTARTE BOREALIS Schum.

The specimens illustrated on this Plate were collected near Cape Sheridan, Grant Land, N. Am., at Lat. 82° 16′, by Charles Percy, Esq., of the Peary Expedition, Sept. 1, 1905; at a point two miles inland and at an elevation of about 100 feet above sea level. This must have been on a raised beach, consequently they are in a *semifossil* condition. Some of them, however, retain the black silky epidermis and are all in a quite perfect condition of preservation.

They all differ considerably in form and features from any of the figures of *A. borealis* Schum. that I have been able to see; and differ enough from most figures to be classed as a distinct species. It, however, has already received so many distinct specific designations, that it is not worth while to add to their number.



SEMIFOSSIL SHELLS.

56.57(78.8)

Article III.— FOSSIL INSECTS FROM FLORISSANT, COLORADO.

By T. D. A. Cockerell.

Plate V.

NEUROPTERA.

Hemerobiidæ.

Polystœchotes piperatus sp. nov.

Plate V, Fig. 2.

Anterior wing about 30 mm. long and 13½ broad, of the same structure, general form and appearance as in the living *P. punctatus* (Fabr.), but the costal area is much broader (its breadth near the base about 4 mm.), and the apex is more rounded less produced, and not at all inclined to be falcate. The peppery markings, very well preserved, are very like those of the recent species, including the subterminal rather vaguely indicated band, which is about 3 mm. from the margin. The costal region is more or less blocked out into alternating light and dark areas, as can be seen in the recent species.

Florissant, Station 14 (*Geo. N. Rohwer.* 1907). *Typha lesquereuxi* occurs on the same slab.

Panorpidæ.

Panorpa arctiiformis sp. nov.[1]

Plate V, Fig. 11.

Length of wings about 13 mm.; a species with light bands on a dark ground, after the manner of *P. nuptialis* Gerst., from Texas. In *P. nuptialis* there are two light V-like marks, the first pointing outwards, the second downwards, and also a transverse light band. In the fossil, the first V is represented by a broad pale band, which includes most of the base of the wing; the second V is present, very broad, with its outer side bulging conspicuously (it bulges slightly in *nuptialis*); the subapical band (straight and comparatively narrow in *nuptialis*) is very broad, and has externally a sharp tooth-like process about the middle, and internally, near the lower end, a large process directed inwardly. The whole appearance of the insect strongly recalls a small Arctiian moth.

The closest affinity is found with *P. picta* Hagen, from Smyrna. *P. picta* has the same markings, or nearly so; the black apical area has the inner edge zigzag, as in *P. arctiiformis*, whereas in *P. nuptialis* it is straight. *Panorpa rigida* Scudder, also a Florissant fossil, is closely allied. The third dark band (the last before the dark apex) is narrower than the white space on either side of it, in costal region, in *P. rigida*, whereas in *arctiiformis* it is broader. *P. rigida* is also smaller than *arctiiformis*. The type of *rigida*, in the Museum of Comparative Zoölogy, was compared.

---

[1] Briefly described in Science, 1907, p. 446.

ODONATA.

AGRIONIDÆ.

Agrion telluris *Scudder.*

Plate V, Fig. 10.

A good nymph from Florissant, Station 14 (*Geo. N. Rohwer*, 1907). I have compared it with Scudder's type, and have no doubt of its identity. Whether its exact generic position can ever be settled, I do not know; it is very probably a member of one of the extinct genera described from Florissant. Superficially, at least, even to the characteristic markings on the legs, it is exceedingly like the nymph of *Hyponeura lugens* Hagen (*cf.* Needham, Proc. U. S. Natl. Museum, XXVII, Pl. xlii, fig. 5), which I collected in New Mexico. The caudal flaps, however, are more attenuate basally, after the manner of *Nehallenia irene* Hagen. According to Needham, *Hyponeura* is one of the most generalized, *Nehallenia* one of the most specialized, of the Agrioninæ.

DYSAGRIONINÆ subfam. nov.

In Proc U. S. National Museum, Vol. XXVIII, p. 167, Mr. E. B. Williamson gives a table of the families and subfamilies of Zygopterous dragonflies, in which the *Calopterygidæ* are divided into two groups, as follows:

Antenodals 2	Subfamily *Lestinæ*.
Antenodals 4 or more	Subfamily *Calopteryginæ*

The *Agrionidæ* almost invariably possess only two antenodal crossnervures, but there is a group of the American Tertiaries, here proposed as a subfamily Dysagrioninæ, in which these nervures are more numerous. We thus have:—

Antenodals 2	Subfamily *Agrioninæ*.
Antenodals 4 or more	Subfamily *Dysagrioninæ*.

Dysagrion Scudder, the type of the subfamily, has not been supposed to possess an unusual number of antenodals, but it is evidently allied to *Phenacolestes,* which has five; and Scudder's figure of *Dysagrion fredericii* shows two antenodals *beyond* the arculus, and as the first two of all Agrionids must certainly have been present, there were at least four.

Phenacolestes mirandus gen. et sp. nov.

Plate V, Fig. 13.

Length of wing 26 mm.; breadth 7¼. Hyaline, with a large reddish-brown iridescent cloud in apical part, from level of origin of ultranodal sector (M_{1A}) to level of base of stigma.

Antenodal sectors five, of which only the first two continue to the radius, these being the two present in Agrioninæ. The second, however, does not meet, or nearly meet, the arculus, but ends on the radius 204 μ beyond it (a character also of *Melanagrion*). Antenodal costa arched.

Basal space long and narrow, breadth at apex about 714 μ, length nearly 5 mm.

Quadrangle with no cross-veins, and with its upper side not much shorter than its lower. Its apex is much less oblique than in *Melanagrion,* more as in *Cænoneura.* Its apical margin is parallel with the succeeding cross-veins, a character of *Disparoneura, Idioneura* and *Cænoneura.*

Arculus angulate in the middle, at which point the lower branch of the media leaves it; the upper branch leaves a little nearer to its fellow than to the radius. (In *Melanagrion* the first branch arises nearer to radius.) This arrangement is about as in *Megapodagrion.* In another specimen, however, the lower part of the arculus is conspicuously the longest, so that the two nervures leave close together from its upper third.

Subquadrangle with a cross nervure and formed as in *Megapodagrion* and *Melanagrion,* but the first cross-nervure from Cu_2 to margin, which falls beneath the apical part of subquadrangle, is a little more than its length from the end of the latter, not close to the end as in *Megapodagrion* and *Melanagrion.* A similar condition occurs in *Agriocnemis.*

In another specimen the first cross-nervure from Cu_2 to margin is distant from end of subquadrangle only a little over half its length.

Nodus 10 mm. from base of wing.

Median sector (M_3) separating from M_{1+2} nearer nodus than arculus, i. e. about 3⅓ mm. from arculus and 2⅓ from level of nodus. This character separates it from the *Calopterygidæ,* and agrees essentially with *Lithagrion* and *Dysagrion*; but the separation is not nearly so near the nodus as is usual in *Agrioninæ.*

Postnodal sectors 21. (27 in *Melanagrion*; 16 in *Lithagrion*; 18 to 19 in *Dysagrion;* 14 (anterior wing) to 17 (hind wing) in *Megapodagrion*).

Stigma elongated, bounding 4 cells above, herein resembling the *Lestinæ, Archilestes,* etc. Seven cells beyond stigma. No brace.

Media. M_1 and M_2 separating about 9⅔ mm. from arculus; four simple cells (varying to three) between them before the doubling begins; then eight before the quadrupling; three rows of cells between the ultranodal sector and M_2 from apex of wing to level of posterior third of stigma (7 cells on extreme margin). The ultranodal sector and M_2 do not approach apically, as they do in *Megapodagrion*, *Ortholestes* and *Melanagrion*, but run parallel from their widest point (opposite apex of stigma) on. This is like *Dysagrion*, and the Calopterygid *Devadatta*. The great number of cells in this region is a Calopterygine feature.

Between R_3 and M_2 there are eight cells on apical margin, then six, then four, then about four series of three, then four double, then 19 single back to origin of R_3, but five of these are basad of origin of M_2.

R_3 originates at level of nodus, the general arrangement, except as to the multiplication of the cells distally, being nearly as in *Argia* and the Agrionines generally, not at all as in the Calopterygines.

Beyond the quadrangle there are four cells, then two pairs, then about six series of three (becoming oblique), and many small cells in the marginal area. Beyond the subquadrangle are 16 simple cells before the doubling begins, and Cu_2 is arched downwards for the first part of its course (as also in *Dysagrion*), suggesting *Pseudophæa* and *Epallage*.

Between Cu_2 and the lower margin there are four cells at the widest part.

Hab.— Florissant, Station 14, two specimens (*S. A. Rohwer*).

Phenacolestes (?) parallelus sp. nov.

The generic position of this species remains a little doubtful, because only the apical half of the wing is preserved. It differs from *P. mirandus* in having the apex more produced beyond the stigma, and the light apical area (beyond the dark cloud) is larger.

Stigma bounds five cells above.

Cells between M_1 and M_{1A} (ultranodal sector) are single, not double, as far back as seven cells basad of level of stigma.

The cells between ultranodal sector and M_2 are regularly three deep only four cells from margin.

The cells between M_2 and R_3 (radial sector) are only three deep even at margin, they extend three deep about eight cells back, thus M_2 and Rs run practically parallel for a long distance, instead of rapidly approaching from the margin as in *P. mirandus*.

Hab.— Florissant, Station 14 (*W. P. Cockerell*).

If one takes a section of the wing down from the basal part of the stigma to Cu_2, and counts the numbers of rows of cells successively met between the longitudinal veins, it is possible to construct a formula, in which each number corresponds to the number of cells found, commencing with that between R_1 and M_1. According to this plan, the formulæ for the two species of *Phenacolestes* are:

P. mirandus, 1, 1, 3, 3, 3, 3, 3, 2.
P. parallelus, 1, 1, 2, 2, 3, 3, 3, 1.

In *Dysagrion* the region below Cu is filled with pentagonal cells; in *Lithagrion* it is filled with quadrilateral cells, or mostly so. *Phenacolestes* resembles *Dysagrion* in the mostly pentagonal cells below Cu_1 but these are not so numerous as in *Dysagrion*.

In the origin of M_2 *Phenacolestes* agrees with *Lithagrion*. It agrees with *Dysagrion* in the apical nervure of the quadrangle being parallel with the succeeding nervures, but differs in the much longer quadrangle, which is herein more like that of *Lithagrion* and *Melanagrion*. In having the cells between nodus and stigma mostly broader than high it agrees with *Lithagrion*.

Lithagrion and *Melanagrion* do not belong to *Dysagrioninæ*, as recently discovered materials, yet to be described, clearly show. I have examined Scudder's type of *Melanagrion umbratum*.

In an account of *Lithagrion hyalinum* Scudder (Bull. Amer. Mus. N. Hist., XXIII, 137) I observed that there was a brace vein, not shown in Scudder's figure. Unfortunately, in inking in the photograph the artist drew a straight vein instead of the brace, which can still be seen faintly indicated. Some months later, I examined Scudder's type of *L. hyalinum*, and found that *there was no brace vein*! Also, I could see only one antenodal cross-vein. The vein from the inner corner of stigma is in line with the inner side of stigma, and so hardly oblique; it looks like the other cross-veins. Notwithstanding these discrepancies, however, I think that my *L. hyalinum* and Scudder's are one species.

I am very greatly indebted to Dr. Needham for advice on *Phenacolestes*, and for a photograph of *Megapodagrion*. Dr. Needham writes concerning *Phenacolestes mirandus*: — "It is indeed a most interesting fossil, another synthetic type. I agree with you that it is Agrionine rather than Calopterygine, in spite of the many antenodals. De Selys *Podagrion* group of Agrioninæ includes the most primitive members of that subfamily, and this fossil is more primitive in several characters than any living forms — especially in the more numerous antenodals, and cross-veins beyond the quadrangle and before the level of the nodus."

ORTHOPTERA.

LOCUSTIDÆ.

Anabrus caudelli sp. nov.

Plate V, Fig. 9.

♀. Represented by the hind part of the abdomen, with the ovipositor, excellently preserved. The ovipositor is about 18 mm. long, and in size, structure and appearance exactly agrees with that of *A. coloradus* Thomas, except that it is perhaps very slightly more curved, and the apex (in lateral view) is distinctly more attenuate.

Florissant, Station 14 (*Geo. N. Rohwer*, 1907). Named after Mr. A. N. Caudell in recognition of his recent valuable revision of the Decticinæ.

This ovipositor was compared with Scudder's types of Florissant Orthoptera. It is much too slender for that of *Lithymnetes guttatus.* Compared with that of *Orchelimum placidum* it is shorter and more curved; the length of the ovipositor of *placidum* is about 16 mm., of *caudelli* between 18 and 19.

GRYLLIDÆ.

Lithogryllites lutzii gen. et sp. nov.

Plate V, Fig. 12.

Length 13 mm., apterous; reddish brown, not dark; anterior and middle legs normal, but quite stout, the anterior tibiæ about 700 μ diameter; hind femora swollen as usual, about 6½ mm. long and 2 broad; hind tibiæ 4 mm. long and about 830 μ broad; chitinous rings of middle abdominal segments about equal, some 850 μ long (in anteroposterior direction) and 4 mm. wide.

Hind tibiæ serrate with very short broad spines, in a row along the inner hind margin; the larger of these are about 153 μ long and 119 broad at base, the smaller less than half that size. These spines are placed close together, so that there are six in a distance of 850 μ. I see, poorly indicated, a spine about 221 μ long and 34 broad, thus short and slender, which may belong to a second row close to the first, but I am not sure that it is not of extraneous origin.

At the apex, the hind tibiæ have three large spines and one smaller one, at least.

The innermost of the large ones is about 1020 μ long and 255 broad.

The middle tibiæ have short spines like those on the hind ones; apparently, but not certainly, in two series.

Hab.— Florissant, Station 14 (*S. A. Rohwer*, 1907). Named after Mr. F. E. Lutz, the author of some interesting statistical studies of Gryllidæ.

The specimen is not so perfect as one could wish, but it seems not to fit well in any modern genus. It may not be mature, but I think it is an adult male. *Pronemobius* Scudder, was based on three species of crickets from the Green River shales of Wyoming, remarkable for the total absence of spines on the hind tibiæ. Among the living genera, some are said to have the hind tibiæ serrate or serrulate (subf. Myrmecophilinæ), some spinose and serrate (subf. Eneopterinæ), and others spined (subf. Gryllinæ &c.). *Lithogryllites* belongs very decidedly to the serrate or serrulate division; the comparatively large size and the normal hind femora exclude it from *Myrmecophila*; the apical spurs of the hind tibiæ being apparently only four (surely not six), it is apparently not a *Mogoplistes.* The anterior legs appear to be much more robust than in *Cycloptilum.* There is a certain resemblance to *Ectatoderus,* but again the anterior and middle legs are much too robust, and the hind femora are much too short, not nearly reaching the end of the abdomen (extending beyond it in *Ectatoderus*). There appears to be no particular resemblance to the *Eneopterinæ.*

It may be supposed that the tibial armature of the Gryllidæ arose as a fine serrulation, and is little advanced in such forms as *Lithogryllites.* A much more developed stage is found in *Gryllus*, and the most developed in *Nemobius,* in which the long spines are movable. It is noteworthy that the basitarsus of *Gryllus* retains the *Lithogryllites* form of armature.

The genus *Myrmecophila* being very different from the other American forms assigned to the Myrmecophilinæ, it would seem that the latter might well be separated as a subfamily Mogoplistinæ. The Mogoplistinæ (Myrmecophilinæ B of Kirby) would then include *Mogoplistes* (Europe, Africa, Florida, and doubtfully Chili), *Microgryllus* (Chili), *Ornebius* (Asia, Polynesia, Florida, Cuba, Mexico, Argentina), *Ectatoderus* (Africa, Asia, West Indies, S. America, Lower California, California, New Mexico), *Cycloptilum* (U. S., Cuba, Brazil, Galapagos Is.), *Arachnocephalus* (S. Europe, N. Africa, Malay Archipelago, Fiji) and *Lithogryllites.* This distribution lends support to the idea that it is a waning type, formerly dominant, but now retreating before the higher forms. From the notes given by Messrs. Rehn and Hebard in Proc. Acad. Nat. Sci. Phila., 1905, pp. 48–49, it would appear that these insects are usually arboreal. They were captured on *Quercus* and *Ilex*, and these genera of trees were prominent in the Miocene Flora of Florissant.

DIPTERA.

GLOSSINIDÆ.

According to Austen, *Glossina* is a very aberrant member of the Muscidæ, "exhibiting several unique structural features, in addition to a very peculiar mode of reproduction." As, however, it is certain that the Muscidæ of authors is too heterogeneous to form a single family; and since we have evidence of the antiquity of *Glossina,* and its fidelity to its own peculiar type through long periods and extensive migrations, it seems better to treat it as belonging to a distinct family.

Glossina oligocena (*Scudder*).

Palæstrus oligocenus SCUDDER, Bull. 93, U. S. Geol. Survey (1892), p. 19.

Scudder describes *Palæstrus* as "a genus of Œstridæ remarkable for the very striking course of the fourth longitudinal vein, which finds no counterpart in living Œstridæ so far as I can find. Nor, indeed, can I discover anything of the sort among the calyptrate Muscaria....The genus seems most nearly allied to *Hypoderma*." One specimen was known, from Florissant.

Austen (Monog. Tsetse-flies, 1903, p. 66) says: "While there are many noticeable differences, the venation of the wing of *Glossina* resembles that of the Œstrid *Hypoderma* (Warble-flies) more closely than that of any other genus, especially as regards the shape of the first posterior cell.... But in the wing of *Hypoderma* the anterior transverse vein is not oblique, and the fourth longitudinal vein before reaching it is not bent down in the manner so characteristic of *Glossina*."

A new specimen of *Palæstrus oligocenus*, found in 1907 by Mr. Geo. N. Rohwer at Station 14, Florissant, shows that the fossil insect is no Œstrid, but belongs to the Glossinidæ, and in fact is not separable from the genus *Glossina*. The formidable proboscis, about 6½ mm. long, is excellently preserved; the venation is exactly the same, except that the anterior basal cell is not quite so much produced apically; the abdomen, about 7½ mm. wide and 8½ long, is hairy as in the living species; the legs, with the hairy femora and comparatively stout tarsi, do not differ. The wings and thorax are as described and figured by Scudder. Not having seen the mouth parts, it is not surprising that Scudder referred the fly to Œstridæ, especially in view of the resemblance between *Glossina* and *Hypoderma* in the venation. The occurrence of the African *Glossina* in the American Miocene is a fact of especial interest, in view of its possible connection with the extinction of the American Equidæ.

The type of Scudder's *Palæstrus*, in the Museum of Comparative Zoology, has been carefully compared with our specimen, and no difference found.

CECIDOMYIIDÆ.

Cecidomyia (?) **pontaniiformis** sp. nov.

Plate V, Fig. 7.

An oval gall on the leaf of *Myrica drymeja* (Lx.) Kn., very closely resembling those formed by the species of *Pontania* on *Salix*. The gall is about 8 mm. long, and 5 broad, one side being contiguous to the midrib. Several examples were found. Florissant, Station 14 (*T. D. A. Cockerell*, 1907).

TIPULIDÆ.

Tipula maclurei *Scudder*.

Plate V, Fig. 8.

A very fine specimen, with the reverse, was collected by myself at Station 13. I compared it with Scudder's type (Museum of Comparative Zoology), and found it to agree excellently. Especially characteristic are the oblique markings on the abdomen, and the dark V formed by the shading of the inner side of cell VII_1. This is only the second example known.

LEPIDOPTERA.

NYMPHALIDÆ.

Nymphalites scudderi *Beutenmüller & Cockerell,* sp. nov.

Plate V, Fig. 6.

Anterior wing 39 mm. long; the lower margin about 23 mm., the outer about 26, the last practically straight, with a barely perceptible outward curve; apex pointed, forming an acute angle; costa almost straight, faintly arched, except at extreme base, where it is quite strongly arched; coloration apparently dark, except for a broad but rather obscure subterminal light band, about 4½ mm. from the outer margin (with which it is parallel) and 3 mm. broad; this band appears to be continued, perhaps less distinctly, on to the hind wings.

Hind wing about 26 mm. long, with the costa full and arched; the anal angle unfortunately destroyed. Venation not visible.

Body apparently about 22 mm. long, the head destroyed except at one side; thorax and abdomen (the latter doubtless flattened sideways) robust; thorax 6½ mm. long, the same wide; width of abdomen 4½ mm.

Florissant, Station 14 (*S. A. Rohwer*).

Very distinct by its large size, and produced apices of anterior wings. The markings recall forms of *Basilarchia,* but the shape of the wings is different. The generic name *Nymphalites,* founded by Scudder, includes Nymphalidæ of uncertain position.

COLEOPTERA.

SILPHIDÆ.

Necrodes primævus *Beutenmüller & Cockerell,* sp. nov.

Plate V, Fig. 1.

Length about 17 mm., with the general form and appearance of *Necrodes* (or *Silpha*) *surinamensis*, but the elytra short, about 11 mm. long. The broadly expanded thorax is formed as in *surinamensis*, with the lateral areas finely and conspicuously punctured, as in that species. The large scutellum is also finely punctured, and has a shield-shaped outline, broad above, just as in *surinamensis.* The elytra, as in *surinamensis*, have three longitudinal keels, all equally long, and converging moderately at the end. The abdomen, as is usual in these insects, projects beyond the elytra, in this case no doubt extended as a result of pressure. The hind femora are strongly incrassate.

Florissant, Station 14 (*S. A. Rohwer*, 1907).

Except for the much shorter elytra, it is difficult to separate this species by any tangible characters from the living *N. surinamensis* (Fabr.).

CERAMBYCIDÆ.

Dryobius miocenicus *Beutenmüller & Cockerell*, sp. nov.

Plate V, Fig. 5.

Elytron, length about 18 mm., breadth near base about 4; apex narrowly truncate, with a tooth at the inner corner exactly as in the living *D. sexfasciatus* Say; punctures strong on the basal fourth of the elytron, weak and scattered beyond, precisely as in *sexfasciatus*. It differs from *sexfasciatus* in the relatively somewhat broader elytra, and the presence of only two, instead of four, light bands. These bands are broad, one beginning about 2 mm. from the apex, and about 2 mm. in width; the other beginning about 4½ mm. from the subapical, and about 3 mm. wide.

Florissant, Station 14 (*Wilmatte P. Cockerell*, 1907).

Phymatodes volans *Beutenmüller & Cockerell*, sp. nov.

Plate V, Fig. 4.

Ventral surface, with elytra and wings expanded. Length about 10½ mm.; length of elytra about 5 mm., their width about 1⅓; length of wings about 6⅓ mm. Elytra broadly dark basally, after which comes a somewhat oblique rather narrow light band, then a narrow dark area, then a large light area, and the apex is dark. Under side of head and prothorax conspicuously transversely striated. Femora bottle-shaped, as is normal in the genus. Apex of abdomen truncate, slightly emarginate, as is usual in the genus. Coxæ normal.

Florissant, Station 14 (*S. A. Rohwer*, 1907).

Allied to the living *P. varius* Fabr., but the light areas on elytra are much more extensive.

Phymatodes dimidiatus, Kirby, lives at Florissant to-day.

ACARINA.

ERIOPHYIDÆ.

Eriophyes (?) **beutenmülleri** sp. nov.

Plate V, Fig. 3.

Small subtriangular galls, about 2 mm. diameter, at the angles formed by the junction of the principal lateral veins of the leaf with the midrib; four galls on the leaf found, 2 to 5 mm. apart.

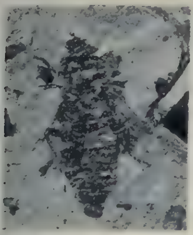
The leaf is broadly lanceolate, with a tapering base and irregularly serrate margins; the apical part is wanting. It is possible that the leaf should be referred to *Salix*.

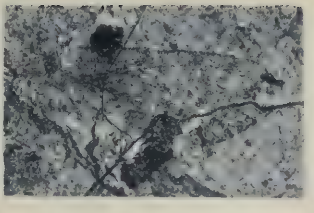
Florissant, Station 14 (*Geo. N. Rohwer*, 1907).

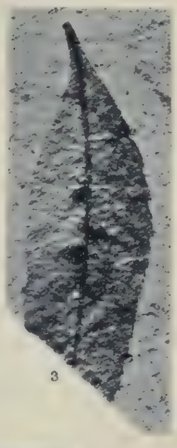
Mr. Beutenmüller suggested to me that this gall was the work of a mite, and it certainly resembles very much various *Eriophyes* galls.

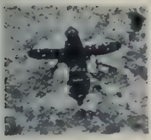
EXPLANATION OF PLATE.

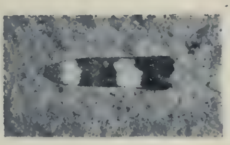
1. *Necrodes primævus* Beutenmüller & Cockerell sp. nov., nat. size.
2. *Polystœchotes piperatus* sp. nov., nat. size.
3. *Eriophyes* (?) *beutenmülleri* sp. nov., nat. size.
4. *Phymatodes volans* Beutenmüller & Cockerell sp. nov., nat. size.
5. *Dryobius miocenicus* Beutenmüller & Cockerell sp. nov., nat. size.
6. *Nymphalites scudderi* Beutenmüller & Cockerell sp. nov., ½ nat. size.
7. *Cecidomyia* (?) *pontaniiformis* sp. nov., nat. size.
8. *Tipula maclurei* Scudder., nat. size.
9. *Anabrus caudelli* sp. nov. ♀, nat. size.
10. *Agrion telluris* Scudder, nat. size.
11. *Panorpa arctiiformis* sp. nov., nat. size.
12. *Lithogryllites lutzii* gen. et sp. nov., nat. size.
13. *Phenacolestes mirandus* gen. et sp. nov., nat. size.

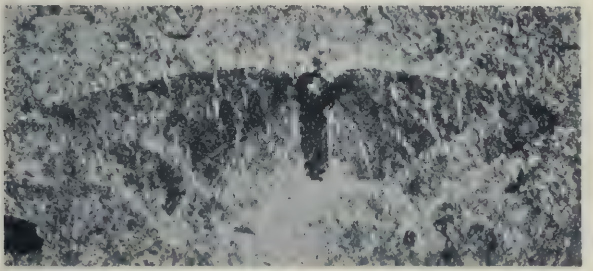

1

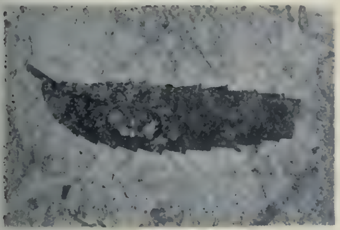

2

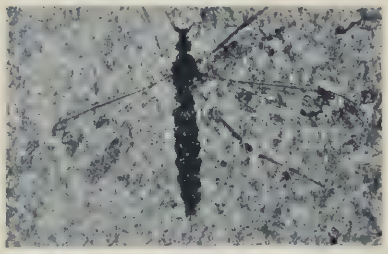

3

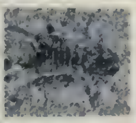

4

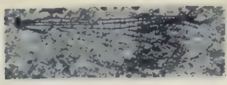

5

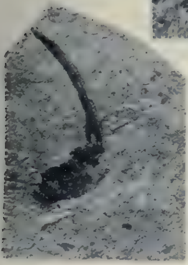

6

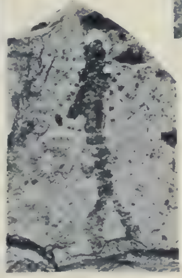

7

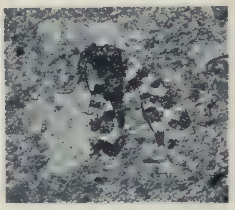

8


12


13


9


10


11

Fossil Insects, Florissant, Col.

56.1(78.8)

Article IV.— THE FOSSIL FLORA OF FLORISSANT, COLORADO.

By T. D. A. Cockerell.

Plates VI–X.

The flora of the Florissant shales, as enumerated below, includes about 106 genera. The material obtained by the expedition of 1906 includes many genera and species not now reported, and it is probable that still others exist in various collections. In working over the new forms, I have selected for description and illustration those which seemed most characteristic, or which could be certainly referred to the vicinity of known living species, and have put aside for later study those which were either very imperfect, uncharacteristic, or of quite doubtful affinities. Some belonging to the last category, but well preserved, have been transmitted to Dr. Hollick, who has kindly promised to describe them if he can determine their systematic position.

So many mistakes in classification have been made by the most eminent palæobotanists, that those who follow in their footsteps may well regard error as inevitable. The precision which is possible in working up certain groups of fossil insects (*e. g.*, the dragonflies) or vertebrata, is quite out of the question in palæobotany, except in comparatively rare cases. On the other hand, however, plant remains are preserved in many more localities than those of land animals, and the specimens of the several species are frequently numerous and easily recognizable, so that for geological purposes they are exceedingly serviceable. It is probable, also, that the continued study of fossil plants, especially in comparison with living forms, will gradually yield results much more accurate than those yet attained. This will especially be the case if sufficient coöperation can be secured, so that the placing of difficult forms may not rest wholly on the opinions of single individuals. Fossils cannot be run down in the ordinary botanical keys, and it is almost impossible for any single man to have such a knowledge of the form and structure of leaves as to place all the members of an extinct flora, or determine certainly whether they belong to living genera. The relative abundance of the different species in the vicinity of Lake Florissant cannot be determined from the frequency of their occurrence in the shales. *Fagus longifolia, Populus lesquereuxi,* etc., which occur in great numbers, evidently grew on the very margin of the lake. Other species, represented by few or single specimens, may have been common enough on the surrounding hills, but so far from the water that their leaves were rarely carried to it. The accidental character of the occurrence of various species in the lake, and consequently in the shale, makes it practically impossible to exhaust the possibilities of the locality, and a fine leaf of some hitherto unknown plant may be uncovered at any moment. At Station 14, where so many new species were found, there was some evidence that a small stream had flowed into the lake, perhaps carrying debris from the uplands. Of the 106 genera, 45 occur in Colorado to-day, namely: —

Chara (?)
Fontinalis.
Hypnum.
Phegopteris.
Dryopteris.
Pellæa.
Isoetes (?) [1]
Pinus.
Sabina.
Typha.
Potamogeton (?)
Stipa.
Acorus.
Juncus
Populus.
Salix.
Betula.
Alnus.
Quercus.
Celtis.
Persicaria.
Odostemon.
Saxifraga (?)
Philadelphus.
Ribes.
Rosa.
Amelanchier.
Cratægus.
Sorbus.
Ptelea.
Rhus.
Schmaltzia.
Pachistima (?)
Acer.
Rhamnus.
Vitis.
Malvastrum.
Aralia (?)
Oxypolis.
Vaccinium.
Fraxinus.
Mimulus.
Aster.
Carduus.
Parthenocissus.

The apparent absence of *Picea*, *Pseudotsuga* and *Abies* is to be noted. Of the genera not found in Colorado, the following 36 occur in our eastern and southern states, about eleven being exclusively southern: —

Onoclea.
Woodwardia.
Spirodela.
Hicoria.
Juglans.
Comptonia.
Morella.
Carpinus.
Castanea.
Ulmus.
Planera.
Morus.
Ficus.
Aristolochia.
Persea.
Hydrangea (?)
Liquidambar.
Leucæna.
Cercis.
Acacia.
Fagara (?)
Cotinus.
Ilex.
Celastrus.
Staphylea.
Sapindus.
Tilia.
Andromeda (?)
Bumelia.
Diospyros.
Osmanthus.
Sicyos (?)
Melothria (?).
Aneimia (sens. latiss.)
Myrsine (sens. latiss.) — Florida.
Dalbergia — Florida.

It is thus evident that a flora similar to that of the Carolinian region occupied the Rocky Mountains during the Miocene; whether it persisted into the Pliocene we do not know. The increasing cold and aridity is of course quite sufficient explanation for its disappearance.

While some of the genera are to-day decidedly southern, we do not know that they may not have possessed a few hardier species in Miocene times. In any case, the flora certainly cannot be described as a tropical one. Two of the genera, *Weinmannia* and *Myrica*, exist to-day in the *mountains* of Jamaica and other tropical localities. *Sequoia*, as is well known, has retreated to California. *Zizyphus* is common in Texas and New Mexico.

---

[1] The (?) indicates that the generic identity of the fossil plant is in doubt, usually because of imperfect material.

The following seven generic names are applied to fossils of which the general relationships only are known, and have no great significance as members of the Florissant flora: —

Najadopsis *Heer.*
Celastrinites *Saporta* (?)
Apocynophyllum *Unger* (?).
Mimosites *Bowerbank* (?).
Palmocarpon *Lx.* (?).
Lomatites *Saporta.*
Banksites *Saporta* (?).

Of those marked with a query, one is very doubtfully from Florissant, and the others are probably not correctly assigned even to the "blanket genera" in which they are placed.

Podogonium Heer, is a well-known genus of the European Miocene, but the Florissant material is very incomplete, and may not be truly congeneric. Another American *Podogonium, P. americanum* Lx., is described from the Laramie and Montana formations of Wyoming, but the evidence as to generic identity is if anything even more unsatisfactory.

The remaining twelve Florissant genera exist to-day in distant parts of the world, as follows: —

Tmesipteris *Bernh.* Australian Region, and Mts. of Philippines. The generic position of the Florissant fossil is perhaps not beyond question.
Engelhardtia *Leschen.* East Indies, Indian Archipelago and S. China.
Lomatia *R. Brown.* Australia, Tasmania, Chile.
Pterocarya *Kunth.* Asia, including Japan.
Melia *L.* Africa and Asia, including Japan.
Santalum *L.* E. Indies and Australia. Generic position of Florissant plant doubtful.
Amygdalus *L.* Asia. One American species.
Paliurus *Juss.* Asia, including Japan.
Buettneria *L.* Mainly tropical America, but also in East Indies and Madagascar.
Sterculia *L.* Tropics of both hemispheres.
Hedera *L.* Palæarctic, to Japan. Florissant plant doubtfully of this genus.
Porana *Burm.* E. Indies. Miocene of Europe.

It will be remarked that there is *no strictly Neotropical element whatever.* Of the known localities for fossil plants, the one presenting a flora most like that of Florissant is Elko Station, Nevada. Unfortunately this locality is either poor in species, or has not been well worked, and has yielded only the following: —

Diospyros.
Fagus.
Ficus.
Lycopodium.
Myrica (4).
Planera.
Populus.
Salix (2)
Sapindus.
Sequoia (2).
Thuja.

Most of these genera, however, are also found at Florissant; and the species are said to include the highly characteristic Florissant fossils *Planera* *longifolia*, *Myrica drymeja* and *Sequoia affinis*. It is therefore probable that the Elko Station beds are Miocene, and later than the true Green River formation.

The Green River formation, excluding Florissant and Elko Station, includes the following localities and genera:

(1). *Green River and mouth of White River.*

Acer.*
Acrostichum.
Ampelopsis.
Aralia.*
Arundo (2).
Brasenia.
Equisetum.
Eucalyptus (?).
Ficus.*
Hemitelites.
Ilex (2).*
Juglans (4).*
Juncus.*
Leguminosites (Z).
Lomatia.*
Manicaria.
Musophyllum (? locality)
Myrica.*
Phragmites (in Colo.)
Planera (2)*
Quercus,*
Rhus (in Colo.)*
Sabal.
Salix (?)*
Sapindus.*
Sphærites.
Zizyphus.*
Cyperus.
Ulmus (White R.)*

In this and the following lists the asterisk indicates a Florissant genus.

(2.) *Uinta County, Wyoming.*

Acer.*
Alianthus.
Amygdalus.*
Andromeda.*
Antholithes.
Celtis.*
Cyperacites.
Euonymus.
Flabellaria.
Quercus.*
Typha.*

Not one genus is common to Uinta Co. and Elko Station.

(3.) *Alkali Station, Wyoming.*

Alnus.*
Apocynophyllum.*
Ficus (2)*
Ilex.*
Myrica (2)*
Juglans.*

(4.) *Barrell Springs, Wyoming (? Green River group).*

Equisetum.
Geonomites.
Lygodium.
Poacites.

(5.) *Washakie Station, Wyoming.*

*Rhamnus** *washakiensis* Ckll. (*intermedius* Lx., not S. & H.); species said to extend down to the Laramie Group.

(6.) *Sage Creek, Montana.*

Ilex.*
Sequoia.*

The Green River beds, if we include Elko Station and exclude Florissant, have yielded about 75 species of plants, of which 23 are supposed to be identical with species described by European authors. The combined series is far inferior to that of Florissant, and most of the 24 genera common to both are widespread and of little significance as proofs of contemporaneity. The presence of palms in the Green River beds deserves note.

CHARACEÆ.

Chara (?) **glomerata** *Lx.* A doubtful plant, which Lesquereux himself says "may represent flower-bearing pedicels of *Platanus.*"

Diatoms and desmids must occur in the shale, but so far we have not been able to detect them.

In 1907 Mrs. Cockerell and Mr. Geo. N. Rohwer obtained an excellent "fruit" or sporostegium of *Chara* in a bed containing *Sphærium*, etc. The species will be figured in a later report, but in the meanwhile it may be named **Chara peritula**, sp. nov. and separated from other American fossil species known from sporostegia as follows: —

Sporostegium broader than long, strongly depressed, with 10 spirals *C. compressa* Kn.
Sporostegium spherical, about as broad as long, with six distinct spirals and signs of a seventh . . . . *C. peritula* sp. nov.
Sporostegium ovoid or elliptical, longer than broad.
  8 or 9 spirals . . . . *C. stantoni* Kn.
  12 or 13 spirals . . . . *C. springeræ* Kn.

FUNGI (PYRENOMYCETES).

PLEOSPOREÆ.

Didymosphæria betheli sp. nov.

Scattered, punctiform, perfectly black perithecia, slightly inclined to be in rows longitudinally, but not at all massed, on fragment of leaf of *Typha lesquereuxi* Ckll. The perithecia are circular to suboval, very well defined, with an average diameter of about 170 μ, some reaching about 220 μ.

Station 14. *Tmesipteris alleni* occurs on the same slab.

The small, definite black spots appear to indicate a Pyrenomycetous fungus, and agree quite closely with the recent *Didymosphæria typhæ* Peck.

Mr. E. Bethel has very kindly sent me, for comparison, *Leptosphæria typharum* (Desm.) Karst., found on *Typha latifolia* at Fort Collins, Colo. (*Crandall*); but I think the fossil is not closely allied to this, the general appearance being very different.

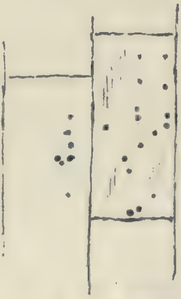


Fig 1. *Didymosphæria betheli* Ckll. Florissant, Sta. 14. On *Typha lesquereuxi* Ckll.

I have named the fungus after Mr. Bethel, in recognition of his important labors on the fungi of Colorado.

MUSCI.

Leaves linear, long-pointed	*Fontinalis pristina* Lx.
Leaves lanceolate or broader, not greatly elongated; plant branching.	
Branches short, somewhat claviform . . .	*Hypnum haydenii* Lx.[1]
Branches numerous, longer and more slender .	*Hypnum brownii* Kirch.

These are all sterile. A fruiting moss, representing a new species, has been described by Mrs. Britton and Dr. Hollick as *Glyphomitrium cockerelleæ.*

SCHIZEACEÆ.

Aneimia (?) **gracillima** (*Lx.*). The *Adiantites gracillimus* Lx., Cret. and Tert. Floras, pl. xxi, p. 8, appears to be an *Aneimia* of the type of *A. aurita* Sw.

POLYPODIACEÆ.

Onoclea reducta sp. nov.

PLATE VI, FIG. 4.

Station 9 (T. D. A. Cockerell). Lower part of sterile frond.

Petiole about 34 mm. long; first segments about 21 mm., second over 30, the whole shaped as in the living *O. sensibilis*, but none of the marginal teeth large or elongated, the intervals between them also apparently greater than in the living species. Venation not preserved.

Much smaller and less strongly dentate than *O. sensibilis fossilis* Newberry.

Phegopteris guyottii (*Lx.*).

Sphenopteris guyottii Lx., Cret. and Tert. Floras, p. 137.

This common fern is much better referred to *Phegopteris* than to the mesozoic genus *Sphenopteris*. The specimens differ greatly among themselves, but so do different pinnæ of the recent *P. dryopteris*, and it does not seem practicable to establish a second species. Perhaps the best material is from Station 13.

Dryopteris scansa sp. nov.

PLATE VI, FIG. 9; PLATE X, FIG. 38.

Station 13. Part of a frond, about 3 cm. long, with ten pinnæ, which project at right angles. Pinnæ 6–13 mm. long, alternate, 4 to 6 mm. apart, very narrow, broadest basally (2–3 mm.); the margins deeply lobed, the lobes obtuse, about three in 6 to 7 mm.; venation very distinct. The general form is somewhat suggestive of *Pellæa atropurpurea*, but that has the pinnæ entire, or lobed at the base, with the veins obscure.

---

[1] This so called moss proves to be a piece of the *Sequoia*, which takes the name *Sequoia haydenii.*

A specimen in the British Museum (v. 2574) is fertile, and shows the sori to be round, and placed at or near the ends of the short lobes of the pinnæ, one to each lobe. The uppermost (terminal) pinnæ (at least 5 or 6) are cuneiform, bluntish, and sterile, as is usual in the genus. The extreme end of the frond is lost, so it cannot be seen whether it is produced. The fertile pinnæ are about 9 mm. long. This specimen, being more complete, and also fertile, should be taken as the type of the species.

Woodwardia florissantia sp. nov.

PLATE VI, FIG. 2.

Station 13. Fertile fronds with long linear pinnæ, over 40 mm. long, and about 4 broad, in all respects formed as in *W. areolata* (L.) Moore.

It is possible that the species ought not to be separated from the modern one. The margins of the pinnæ are entire; no venation can be made out. *Woodwardia preareolata*, Knowlton, is also evidently allied.

Pellæa antiquella sp. nov.

PLATE VIII, FIG. 20.

Station 14. The end of a sterile frond, with its reverse. Similar to *P. stelleri* (S. G. Gmel.) Watt; apical lobe about 17 mm. long and 9 broad, with rounded lateral lobules; at the base of the apical lobe, on one side, a rounded lobe is attached, and below this, after an interval of about 3 mm., is a symmetrical pair of lobes, each over 10 mm. long and about 4½ broad; below these, after another interval, is another pair of smaller lobes.

PSILOTACEÆ.

Tmesipteris alleni (*Lx.*) *Hollick.* Stations 11, 12, etc.; a common fossil at Florissant.

ISOETACEÆ.

Isoetes (?) **brevifolius** *Lx.* Unfigured. There is an *Isoetes* of this name in Europe, but it is considered only a form of *I. velatum* A. Br.

PINACEÆ.

Pinus wheeleri sp. nov.

PLATE X, FIGS. 5, 11.

Station 14. Leaves in clusters of five, 12 cm. or more long, about 1 mm. broad. A cone attributed to this species was found by Dr. W. M. Wheeler at Station 11, at the top of the exposure. It is brown black, with large broad scales in the manner of *P. flexilis*, James. The diameter of the cone is about 30 mm.

Pinus florissanti *Lx.* Stations 9 and 13. Leaves in clusters of three. *P. hambachi* Kirch., is presumably the same.

Sequoia haydeni (*Lx.*) *Ckll.* (= *affinis* Lx). Plate X, Fig. 48. Station 14, etc., abundant. Foliage of two forms, and cones short, subglobular; allied to the modern *S. sempervirens*. After examining a large amount of material, and reading what J. S. Gardner has to say in his *British Eocene Flora, 2*: 29–42, I believe that only one species is represented at Florissant, and that the so called *Glyptostrobus* of that locality must be included in it. The fossil stumps must also be referred here.

In 1907 Mr. S. A. Rohwer found at Station 14 an additional conifer, represented by a beautifully preserved twig with about ten branchlets, which are an inch or less long. It may be named **Heyderia coloradensis** sp. nov. and compared with the recent *Heyderia decurrens* (Torrey) K. Koch, of California, with which it almost exactly agrees. The larger leaves are about 5½ mm. long, and perhaps less acutely pointed than in the living plant. The foliage is in general better developed than in most specimens of *H. decurrens*, but scarcely more so than in a plant in the herbarium of the New York Botanical Garden, which was collected by Torrey in 1865 in the grove of *Sequoia gigantea* in California. It is of much interest, as showing the persistence of a plant association through a long period, to note that the fossil *Heyderia* also occurred in a *Sequoia* grove, a piece of *Sequoia haydeni* being actually preserved on the same slab, and touching the *Heyderia*.

Heyderia is the American *Libocedrus*, or Incense Cedar. The genus is to-day represented by two species, *H. decurrens* of our Pacific coast, and the *Libocedrus macrolepis* B. & H. of Asia. The segregation of *Heyderia* from the true Libocedrus (of the southern Hemisphere) is here made in accordance with the views of Dr. N. L. Britton, as indicated in conversation and on the sheets at the N. Y. Botanical Garden. I was able to examine material of the true *Librocedrus* also, and since the fossil is obviously *Heyderia*, having the distinctive characters well-marked, it affords an additional argument for the segregation.

JUNIPERACEÆ.

Sabina linguæfolia (*Lx.*) *Ckll.* Station 14. Beautifully preserved. Lesquereux describes a var. *gracilis,* but I have not seen more than one form.

TYPHACEÆ.

Typha lesquereuxi *Ckll.* Plate X, Fig. 46. Station 13, etc.; very common.

ZANICHELLIACEÆ.

Potamogeton (?) **verticillatus** *Lx.* A plant of doubtful relationships. Another Florissant plant, not figured, is referred by Lesquereux to the European *P. geniculatus* Al. Br.

NAIADACEÆ.

Najadopsis rugulosa *Lx.* A problematical plant.

POACEÆ.

Stipa laminarum sp. nov.

PLATE VI, FIGS. 1, 3.

Station 14. Common. The specimens consist of the long-awned grains similar to those of the living *S. comata.* Grain 10–11 mm. long and about 2 broad, its awn quite 60 mm.

ARACEÆ.

Acorus affinis *Lx.*

LEMNACEÆ.

Spirodela penicillata (*Lx.*) *Ckll.*

JUNCACEÆ.

Juncus crassulus sp. nov.

PLATE X, FIGS. 44, 45.

Station 14; common, represented by single flowers. Capsule when well-developed globular, about 3 mm. long, and nearly or quite as broad, dark colored; perianth about 5 mm. long, far exceeding capsule, very pale; style about 2 mm. long, perfectly straight; stigmas less than half length of style.

Probably allied to *Juncus setaceus* Rostk. The large flowers are suggestive of the South American genus *Rostkovia.*

PALMACEÆ. (?)

Palmocarpon (?) *globosum* Lx. A problematical fruit, probably not a palm.

JUGLANDACEÆ.

Based on an involucre . . . . *Engelhardtia oxyptera,* Saporta, Lx.
Based on nuts . . . . 1.
Based on leaves, all with dentate or denticulate borders . . . . . . 3.
1. Nut oval, the apex produced . . . *Hicoria rostrata* (Goepp.) Knowlt.
Nut nearly circular, apex not produced . . . . 2.
2. Nut small, scarcely over 1 cm. long . . . *Hicoria princetonia* n. n.
Nut larger, about 17½ mm. long . . . . *Juglans* (?) *sepultus* n. sp.
3. Leaflet large, 11 cm. long, base rounded, inequilateral . *Juglans florissanti* Lx.
Leaflet about 9½ cm. long, base broad cuneate, equilateral *Juglans affinis* Kirchner.
Leaflets broad-cuneate basally, 6 to 9½ cm. long, base equilateral in terminal one, very inequilateral in lateral ones . *Hicoria juglandiformis* (Sternb.) Knowlt.
Leaflets narrowed to base, but there rounded, obtuse, nearly equilateral in lateral leaflets . . . . . *Juglans crossii,* Knowlt., Kirchner.

Pterocarya americana Lx. described from Middle Park, is probably not a member of the Florissant flora; it is, moreover, quite uncertain generically; Lesquereux's figure shows neither the apex nor the base. **Hicoria princetonia** is the doubtful *Carya bruckmanni* Heer, of Lesquereux (Cret. and Tert. Floras, pl. xxxix, p. 6.) It is not quite clear to me that *Juglans affinis* is not a large terminal leaflet of *Hicoria juglandiformis*; in that case I should be inclined to use Kircher's specific name, regarding the identity of our plant with that of Sternberg (from Bohemia and Galicia) as doubtful.

Juglans (?) **sepultus** sp. nov.

PLATE VI, FIG. 8.

Station 3, in soft red rock (W. P. Cockerell). Fruit globose, about 17½ mm. long and 16 broad, not beaked; apparently thin-shelled, with the seed deeply lobed.

This is the organism published by Lesquereux (Cret. and Tert. Flora, pl. xxxix, f. 5) as *Juglans costata* Unger. Schenk, in Zittel's 'Handbuch,' refers it to *Carya ventricosa*; that is to say *Hicoria ventricosa* (*Juglandites ventricosus* Sternb.) from Central Europe. This latter is said by Unger to have the fruit very like that of *Hicoria alba*; it can scarcely be identical with the Florissant plant, which is probably a *Juglans*, as Lesquereux held. *Juglans costata* (Sternb.) Ung. (from Bohemia) is also a *Carya* (*Hicoria*) according to Unger and Schenk, and should be called *Hicoria costata*.

MYRICACEÆ.

Leaves deeply incised . . . . 1.
Leaves merely dentate or denticulate . . . . 2.
1. Large, tapering to base and apex, nearly 4 cm. broad in middle; reticulate veined (Station 11.) . . . . . . *Comptonia insignis* (Lx.) Ckll.
Smaller, apparently not reticulate veined; doubtfully distinct from the last *C. acutiloba* (Lx.) Ckll.
2. Leaves not or little tapering apically, the sparing dentation only beyond the middle . . . . 3.
Leaves usually narrow, more tapering, dentate to below the middle . . 4.
3. Leaves more obtuse and parallel sided, the teeth only near the apex (? Florissant) . . . . *Morella bolanderi* (Lx.) Ckll.
Leaves less obtuse, the sides more convex, the teeth not only near the apex *Morella hendersoni* Ckll.
4. Leaves large and broad, with sharp teeth of different sizes (Station 9L, W. P. Ckll.) . . . . *Myrica copeana* Lx.
Leaves narrower and more tapering, the teeth not, or not obviously, of two sizes . . . . 5.
5. Leaves distinctly inequilateral at base . *Myrica drymeja* (Lx.) Knowlton.
(I include here *fallax, obscura* and *rigida* of Lesquereux.)
Leaves tapering (long-cuneate) and not obviously inequilateral at base . 6.
6. Teeth very strong and sharp, not very numerous . . *Myrica scotti* Lx.
Teeth smaller, weaker, or more irregular . . . . . *Myrica* sp.?

Myrica sp.?, at the end of the table, includes the leaves referred by Lesquereux to *M. acuminata* Unger, *M. amygdalina* Saporta, *M. zachariensis* Saporta and *M. polymorpha* Schimper. How many, or what, species these really represent seems to me doubtful.

M. drymeja is one of the commonest species at Florissant.

SALICACEÆ.

Based on the calyces . . . . *Populus crassa* (Lx.) Ckll.
Based on leaves . . . . 1.
1. Leaves very broad, often with a more or less cordate base . . . . 2.
Leaves pyriform or subpyriform, base broad and rounded . . . 3.
Leaves lanceolate . . . . 4.

2. Leaf very large, base cordate, blade about 12 cm. long and 14 broad toward base; margin feebly crenulate . . . . . . *Populus scudderi* Ckll.
Leaf not so large, not or hardly cordate; 5 nerved from base *P. arctica decipiens* (Lx.) Ckll.
3. Leaf long-oval, not strictly pyriform, the margins with a gentle even curve above; three nerves from base . . . . . *P. zaddachi* Heer, var., Lx.
Leaf strictly pyriform, the margin beyond middle straight or a little concave; five-nerved from base . . . . *P. pyrifolia* Kirch.
4. Margins entire . . . . 5.
Margins crenulate or dentate . . . . 6.
5. Broadest part of leaf considerably beyond the middle; leaf 8 cm. long *Salix libbeyi* Lx.
Leaf more tapering, broadest point not beyond middle . . *Salix sp.?*
6. Marginal teeth short or obtuse; venation conspicuously camptodrome *Populus lesquereuxi* Ckll.
Marginal teeth fine and acute; venation semi-craspedodrome . . . 7.
7. Leaf less tapering apically, but with a more narrowly cuneate base *Salix ramaleyi* Ckll.
Leaf more tapering apically, but with a broader base *S. ramaleyi rohweri* Ckll.

In addition to the above, the *Populus* (?) *pseudocredneria* is distinguished by the broad leaf with very large marginal teeth, quite unlike those of any of the other species. *Populus crassa* should doubtless be associated with one of the species known from the leaves, but which one we do not yet know. *P. zaddachi* is not, I believe, the species of Heer, but is probably merely a small short leaf of *P. lesquereuxi*, such as we have found on the same branch with normal leaves. *P. oxyphylla* Saporta, Lx., is a leaf similar to *P. pyrifolia*, but small and with remote denticulations. I believe that it is the same species, but that it is probably not Saporta's plant, so the name *pyrifolia* should be preferred. *Salix amygdalæfolia* Lx., will run in the above table to *Populus lesquereuxi* (Plate VIII, Fig. 23), and I strongly suspect that it is founded on small narrow leaves of that species. In any event, the name is unavailable, because of *S. amygdalifolia* Gilib. *Salix* sp.? in the table is merely to leave a place for the possible occurrence of such species as *S. integra* and *S. media*, which Kirchner lists, but I believe erroneously.

Salix ramaleyi rohweri n. var. (Plate IX, Fig. 34) is from Station 14, which I believe is not of the same age as the locality of typical *ramaleyi*. This leaf, as well as *ramaleyi* proper, differ from the more usual type of *Salix* (and conspicuously from "*S. amygdalæfolia*" Lx.) in the semicraspedodrome venation, the secondaries bending upwards apically, but terminating on the margin, nowhere forming perfect festoons. The secondaries in the variety are a little more divergent and a little more numerous. The length of the blade is 11 cm., its greatest width 24 mm.; its width 4 cm. from apex, 15 mm. The teeth are sharp, 6 to a cm.

Populus arctica decipiens (*Lx.*). This leaf, from Station 14, appears to be identical with *Populus decipiens* Lx., 1873, now considered a variety of *P. arctica* Heer. The base, however, is broadly rounded, not cuneate; the apex is also rounded; the blade of the leaf is 31 mm. long and 33 broad. There is a *Populus*-like petiole.

Populus crassa (Lx.).

PLATE VIII, FIG. 22; PLATE V, FIG. 42.

Macreightia crassa LX. Cret. and Tert. Floras, p. 175, pl. XXXIV f. 16, 17. (3-lobed or parted.)

Diospyros cuspidata KIRCHNER, Trans. Acad. St. Louis, VIII (1898), p. 185, pl. xii, p. 1. (4-lobed.)

These calyces are abundant in the Florissant shales at Station 14. They undoubtedly belong to *Populus*, being almost exactly like those of some of the modern species. In the living species, they vary from three to four parted. *P. crassa* should doubtless be associated with some of the fossil leaves, but until they are found connected, such association with any particular species can hardly be made.

Populus (?) **pseudocredneria** sp. nov.

PLATE VIII, FIG. 28.

Station 14; apical part of leaf, more than half. *Planera longifolia* is on the same slab. Type in Am. Mus. Nat. Hist.

Width 48 mm.; probable length of blade about 55 mm.; similar to *Populus* (?) *daturæfolia* (*Credneria* (?) *daturæfolia*, Ward. Types of the Laramie Flora, 1887), and especially to Ward's pl. xliv, f. 1, but marginal teeth not so numerous, being about the same size, though the leaf is so much smaller. The teeth seem to begin about the middle, and to be about three on each side, each about 10 mm. long, the breadth at base 9½ mm. or less, the margins slightly convex for the most part, not so generally concave as in *daturæfolia*. The apical and subapical teeth are notched laterally, producing a small accessory tooth. The venation, so far as preserved, is similar to that of Ward's species. The leaf gives the impression of having been rather thin. Ward himself admits that the reference of his *daturæfolia* (from the Fort Union Group, Montana) to *Credneria* is quite hypothetical. He compares the leaves also with *Ilex*, *Quercus*, *Platanus*, etc., but curiously enough, does not allude to *Populus*, although his pl. xliv, f. 2, could be believed conspecific with *P. subrotundata* Lx., Tert. Flora, pl. xxiv, f. 8. I have compared the venation with that of recent *Populus* leaves and do not find any such differences as seem to forbid generic association. The teeth, which Ward considers especially interesting, are very variable. When least developed (in *daturæfolia*) they recall some of our western cottonwoods; when highly developed (as in some *daturæfolia*, and in our *pseudocredneria*) they remind one of *Populus bolleana* Lauche, from Turkestan, which is usually regarded as a variety of *P. alba*.

The lobes or teeth of *P. pseudocredneria* rather recall those of *Acer indivisum* Lx., but they are more numerous, and the venation is pinnate instead of palmate as in *indivisum.* There is also some resemblances to *Platanus dissecta* Lx., but the leaf of *pseudocredneria* is much smaller, with larger lobes. *P. dissecta* has the venation nearly as in *pseudocredneria,* and looks as though it could possibly be congeneric. There is some resemblance to *Platanus rhomboidea* Lx., from Golden, but the venation is markedly different.

BETULACEÆ.

Carpinus (?) **attenuata** *Lx.* Station 14, on the same slab with, and almost touching, a leaf of *Planera longifolia.* A well-preserved leaf, showing the details of the venation, which do not seem to accord perfectly with *Carpinus* or *Corylus.* In outline, the leaf is like a *Corylus,* such as *C. rostrata*; and I do not believe it is correctly referred to *Carpinus.*

Lesquereux has figured (Cret. and Tert. Floras, pl. xxxix, f. 3) what he calls flowers of *Alnus,* but they seem to me to belong to *Quercus.* On the other hand, we have an excellent pistillate ament of *Alnus* from Station 13. It is ovoid, about 11 mm. long and 7 broad.

Alnus cordata Lx. (Cret. and Tert. Floras, p. 151) is a homonym of *A. cordata* Desp.; it may be called *A.* **præcordata,** n. n.

The following table separates the Florissant species of this family:—

Leaf large, with double serration; tapering (wedge-shaped) at either end, and very broad in the middle . . . . . *Carpinus* (?) *attenuata* Lx.
Leaf with the sides more or less evenly convex, or nearly parallel, as is usual in the family . . . . 1.
1. Leaf elongate, more or less lanceolate, with double serration . . . 2.
Leaf oval or subcordate . . . . 3.
2. Teeth conspicuously of two sizes, large sharp ones terminating the lateral veins, and little ones in the intervals; laterals not very numerous *Betula florissanti* Lx.
Teeth sharp, but not obviously of two sizes; laterals very numerous; sides often nearly parallel (Stations 50 and 14) . . . . . *Carpinus fraterna* Lx. (incl. "*grandis* Ung." Lx.)
3. Leaf doubly serrate; about 6 cm. long; base cordate; laterals eight pairs, opposite . . . . *Alnus præcordata* Ckll.
Leaf simply serrate; base truncate . . . . 4.
4. Leaf larger, laterals fewer and more regular (Station 5) *Alnus kefersteinii* (Goepp.) Ung., Lx.
Leaf smaller, laterals closer and more irregular . . *Betula truncata* Lx.

Our *Alnus* from Station 5 is evidently that figured by Lesquereux as *kepersteinii* from Florissant, but its identity with the plant figured by Unger is questionable, the latter having the laterals or secondaries still fewer and wider apart.

It is a singular thing, that the leaves of the common *Planera longifolia* of Florissant are almost exactly like those of *Betula pumila*, as figured in Britton and Brown's 'Illustrated Flora' (Vol. I, p. 511); but they are not at all like those of *B. pumila* as represented in the herbarium of the University of Colorado!

FAGACEÆ.

Leaf lanceolate, margin entire
species doubtfully referred to *Quercus elæna* Ung. and *Q. neriifolia* Al. Br.
Leaf serrate or dentate or lobed . . . . 1.
1. Leaf lobed . . . . 2.
Leaf dentate (often coarsely) or serrate . . . . 4.
2. Lobes few and more or less rectangular . . *Quercus balaninorum* Ckll.
Lobes more numerous, rounded . . . . 3.
3. Lobes longer; base very narrowly cuneate . . *Quercus lyratiformis* Ckll.
Lobes shorter; base more obtuse . . . . *Quercus ramaleyi* Ckll.
4. Apex abruptly produced, tongue-like, teeth irregular . *Quercus osbornii* Lx.
Apex not thus produced . . . . 5.
5. Leaf oval, with a long petiole; serrations weak
Quercus (?) *florissantensis* Ckll. (*Q. pyrifolia* Lx., not Blume)
Leaf long-oval or longer; marginal teeth strong . . . . 6.
6. Leaf long-oval; teeth irregular *Quercus peritula* n. n. (*Quercus mediterranea* Lx).
Leaf much elongated, approximately parallel sided . . . . . . 7.
7. Base very narrowly cuneate, tapering to the petiole; teeth large and regular
Quercus drymeja Unger, Lx.
Leaf large, probably over 12 cm. long; lateral nervures more numerous than in the last; marginal teeth more numerous . . *Castanea intermedia* Lx.
Leaf large; teeth fewer and more irregular than in the last; base broad
Castanea dolichophylla Ckll.

Quercus serra, Unger, is reported by Lesquereux, without a figure. According to Unger's figures, it resembles *Q. florissantensis*, but is more prominently toothed.

Quercus mediterranea Unger, of Lesquereux (Cret. and Tert. Floras, pl. xxviii, f. 9) is certainly not the species originally described by Unger in 'Chloris Protogaea'; it may take the name *Q. peritula*.

Quercus lyratiformis sp. nov.

PLATE VII, FIG. 17.

Station 14; four leaves on twig. Type in Am. Mus. Nat. Hist.; reverse at University of Colorado.

Leaf similar to *Q. lyrata* Walt., and agreeing with that species and differing from

Q. alba in the very acute basal angle. Probable length of leaf 65–70 mm., the petiole 7 mm., the blade comparatively narrow, its breadth about 18 mm., deeply lobed, the lobes about 5 mm. long, and formed as in *lyrata*, except that none have a secondary lobule, and the sinuses are more acutely pointed.

There is a certain resemblance to *Comptonia insignis* (Lx.) Ckll., but the leaves are much narrower, with more obtuse lobes.

Quercus balaninorum sp. nov.

Plate VIII, Fig. 21.

Station 14. A leaf, lacking the base; as preserved light ferruginous. Form lanceolate, tapering to base and apex, with one or two large rectangular lateral lobes, and some irregular small dentations. Secondary nervures few, near middle of leaf more than 10 mm. apart. Greatest breadth of leaf 28 mm.; breadth 11 mm. from apex 17 mm.; apex not produced.

Much like *Quercus lesquereuxiana* Kn., as figured by Knowlton (1900), but different from Lesquereux's original figures (as *Q. acrodon*), which have sharp teeth, numerous and not far apart. There is very strong resemblance to *Q. emoryi* Torrey, as figured by Sargent (Trees of North America, p. 286), except that in *emoryi* the apex is more tapering. Rydberg's *Q. emoryi* (Bull. N. Y. Bot. Gard., 1901, pl. 32) shows the apex as in the fossil, but the lobes are a little more pointed. There is also a slight resemblance to *Q. prinoides* Willd.

The name is derived from the beetles of the genus *Balaninus*, which doubtless infested the acorns. Scudder has described six species of this genus from the Florissant shales.

Castanea intermedia *Lx.* This was described from "Middle Park," but no doubt really came from Florissant. The so called *Quercus drymeja* Ung., from Bridge Creek, Oregon (Miocene), as figured by Lesquereux (Cret. and Tert. Floras, pl. liv, f. 4) appears to be the same species; it certainly is not Unger's plant. Knowlton has referred it to his *C. pulchella*, a species closely resembling the so-called *C. ungeri*.

Lesquereux recognized three species of *Castanea* from the American Tertiaries; they may be separated as follows:—

Leaf broader, more inclined to ovate, the teeth strong and sharp (Miocene, John Day Valley, Oreg.) . . . . *atavia* "Unger." Lx.
Leaf longer in proportion to its breadth, more parallel-sided . . . . . 1.
1. Leaf large, the teeth short and not very close together (California) *ungeri* "Heer." Lx.
Leaf smaller, the teeth larger and closer together (Florissant) *intermedia* Lx.

Knowlton, applies to the *C. ungeri* the name *C. castaneæfolia* (Unger)

Knowlton, based on the *Fagus castaneæfolia* of Unger. Unger's figure of the latter, however, is almost exactly like the leaf which Lesquereux calls *C. atavia*, and is distinctly different from the leaves figured as *C. ungeri.* According to Knowlton, the *C. atavia* of Lesquereux is identical with "*Quercus*" *horniana* Lx.

Castanea dolichophylla sp. nov.

Station 14 (Rohwer) a single well-preserved leaf; type in Amer. Mus. N. Hist., reverse at University of Colorado. Leaf about 165 mm. long and 25 broad, elongate, the basal half parallel-sided, the apical gradually tapering (about 60 mm. from apex the leaf is about 17 mm. broad, about 40 mm. from apex, 12 mm.); base obtuse, rounded, inequilateral; teeth of the usual form, but rather irregular, and not close together (near middle of leaf about 1 tooth in 10 mm.); petiole about 10 mm. long, somewhat twisted. The base of the leaf is as in the common chestnut.

Distinguished from *C. intermedia* by the teeth being only half as numerous, and in form more like those of the living *C. dentata* (Marsh) Borkh. (*C. intermedia* is more like *C. pumila*). The elongate form and strong teeth distinguish it from *C. ungeri.* The leaf is much like certain species of *Quercus* (e. g., *Quercus drymeja* Ung.), but the base is entirely different. The teeth are not unlike those of *Castanea kubinyi* Kov., especially in their remoteness and comparative irregularity.

ULMACEÆ.

Ulmus tenuinervis *Lx.* (Plate VIII, Fig. 26.) Station 14. A good leaf, with reverse.

Ulmus hilliæ *Lx.* Station 14. Distinguished from *U. tenuinervis* by the broad simple teeth, and very inequilateral base. I am convinced that *Fraxinus libbeyi* Lx., is a synonym; and so also, I believe, is *Ulmus brownellii* Lx.

Planera myricæfolia (Lx.). *Planera longifolia myricæfolia* Lx. 1883 (Station 13) appears to me to be a distinct species, notwithstanding the statements of Lesquereux, and the fact that *P. longifolia* is extremely variable.

The following table separates the Florissant Ulmaceæ: —

Base of leaf equilateral or nearly so . . . . 1.
Base of leaf conspicuously inequilateral . . . . 4.
1. Leaf long-pyriform, feebly dentate, lateral nervures irregular *Celtis mccoshii* Lx.
Leaf oval or lanceolate or oblong, with very strong simple teeth, laterals regular . . . . 2.

2. Leaf oval or oblong . . . . 3.
Leaf lanceolate, laterals forming a very acute angle with midrib, base very narrowly long-cuneate . . . . . *Planera myricæfolia* (Lx.) Ckll.
3. Leaf with only about the apical half toothed; broad, but with cuneate base *P. ungeri* Ett., Lx.
Leaf with much more than apical half toothed; oval or oblong, the broad leaves with obtuse base . . . . *Planera longifolia* Lx. Pl. IX, Fig. 30.[1]
4. Teeth broad and simple . . . . *Ulmus hilliæ* Lx.
Teeth more or less double . . . . 5.
5. Apex tapering, elongated . . . . *U. tenuinervis* Lx.
Apex not so tapering; leaf usually larger . . . *U. braunii* Heer, Lx.
Fruits have been found, and referred hypothetically to *U. braunii.*

MORACEÆ.

Morus symmetrica sp. nov.

PLATE VII, FIG. 19.

A single well-preserved leaf, with reverse. The leaf is almost exactly the color of the shale, with the veins standing out very prominently, dark brown. Length about 57 mm., breadth 38; equilateral; the base truncate, broad; apex not produced; marginal teeth very low, rounded, little developed; venation normal, the lateral veins (5 or 6 on each side) failing just before reaching the margin, or reaching it by very feeble terminations; delicate cross-veins developed at right angles to midrib and lateral veins; first lateral with five veins leaving its lower margin and running to (or nearly to) edge of leaf.

This is much like a *Celtis*, but distinguished by its symmetrical form. I am not positive that it belongs to *Morus*, but it may well do so. There is quite a strong resemblance to *Tilia populifolia* Lx., as figured in Cret. and Tertiary Floras, pl. xxxiv, f. 9; but this figure appears to represent a different species from fig. 8, which is to be regarded as the type-figure of *T. populifolia.*

Ficus florissantella sp. nov.

PLATE IV, FIG. 33.

Station 14. A single well-preserved leaf, 49 mm. long, 34½ broad; entire, broad-oval, pointed apically, the base subtruncate and oblique (inequilateral); secondary nervures about six pairs, joined by fine nervures on lateral margin, as usual in the genus. Leaf moderately thick.

Almost exactly like *F. haydenii* Lx., except that the base is conspicuously inequilateral, and the tip is not prolonged; the lateral nervures at the base are as in *F. haydenii*, and different from those of the otherwise very similar *F. tiliæfolia* Heer. The apex, on the other hand, is as in *F. tiliæfolia.*

---

[1] In 1907 we got fruiting material of *Planera longifolia*, proving that it is no *Planera* but a beech. It takes the name *Fagus longifolia* (Lx.) Hollick & Cockerell.

Ficus arenaceæformis sp. nov.

PLATE VIII, FIG. 24.

Station 14, several specimens. Elongate entire leaves, with inequilateral base, and in good examples showing prominent lateral veins diverging from the midrib at an angle of not less than 60°. The leaves are quite like those of *F. arenacea* Lx. (Tertiary Flora, pl. xxix, f. 1), except that they narrower and more elongate; it is quite possible that they represent only a variety of *F. arenacea*, which is described from the Green River beds in Wyoming. The leaves appear to have exceeded 100 mm. in length, with a breadth near the base of 18–23 mm. A specimen showing only the basal part is taken as the type, as it has the venation more distinctly preserved than the others. In the field, some of these leaves were taken for *Quercus neriifolia*, but that has a quite different base.

There seems to be some confusion about the species of *Ficus* allied to *F. lanceolata*. Knowlton refers *F. arenacea* Lx. in part to *lanceolata* and in part to *F. uncata*. The typical *arenacea* appears however to be a distinct species, differing from *F. lanceolata* by its much broader and strongly inequilateral base. *F. arenacea brevipetiolata* Lx. may well be *F. uncata* Lx., as Knowlton states; but in this case the prior name is *F. gaudini* Lx., 1872, not *uncata* Lx., 1878.

Ficus lanceolata Heer, 1856, is a homonym of the much earlier *F. lanceolata* Buch. Ham. in Roxb. (a living oriental species), and may take the name *Ficus* **navicularis.**

Ficus jynx Unger, is recorded by Lesquereux from Elko Station, Nevada, but his figure shows a leaf with the base much more acute than in Ettinghausen's figures of *jynx*, which he cites. The base of *F. jynx*, as figured by Ettinghausen, is like that of *F. arenacea.*

Ficus trinervis *Knowlton.* Here may belong a *Cinnamomum*-like leaf found by Messrs. Henderson and Ramaley; *cf.* Univ. of Colo. Studies, III, p. 172.

PROTEACEÆ.

Lomatites Saporta, 1873.

Lomatites hakeæfolia (*Lomatia hakeæfolia* Lx. 1883) and *Lomatites spinosa* (*Lomatia spinosa* Lx. 1883) appear to be closely related to *Lomatites berendtianus* (Goepp.) Conw., from European amber. I am indebted to Professor Sargent for a number of species of recent *Lomatia*, and it seems very unlikely that the Florissant plants are truly congeneric with them, while they may apparently be referred with safety to Saporta's genus.

The nominal species from Florissant are as follows:—

Based on a fruit resembling that of *Pinus* . . *Banksites lineatus* Lx.
Based on leaves . . . . 1.
1. Leaves with three subequal lobes . . . . *Lomatia tripartita* Lx.
Leaves elongate, with lateral teeth or lobes . . . . 2.
2. Little lobules between the obtuse lobes, as in some Rosaceæ *L. interrupta* Lx.
No lobules between the lobes or teeth . . . . 3.
3. Lobes rounded, obtuse, very regular . . . . . . *L. abbreviata* Lx.
Lobes pointed, or when rather obtuse, then irregular . . . . . . 4.
4. Lobes elongated, more or less parallel-sided . . . . 5.
Lobes triangular . . . . 6.
5. Apex broad, not lobulate or dentate; lobes very irregular . *L. terminalis* Lx.
Apex narrow, lobulate nearly to point; lobes nearly regular . *L. acutiloba* Lx.
6. Leaf elongate, with a long linear apex . . *Lomatites spinosa* (Lx.) Ckll.
Leaf shorter, with broad base, apex less produced *Lomatites hakeæfolia* (Lx.) Ckll.

L. acutiloba was found at Stations 4, 11 and 14; *L. terminalis* at 4 and 11; *L. tripartita* at 14. It is exceedingly probable that *L. terminalis* and *tripartita* are forms of the same thing.

SANTALACEÆ.

Santalum americanum Lx. is based on a *Lepargyræa*-like leaf, lanceolate with entire margins, and no venation visible except the midrib. Its affinities must be considered doubtful.

POLYGONACEÆ.

Persicaria tertiaria (*Polygonum tertiarium* Small) was described by Dr. Small in his revision of the North American species of *Polygonum* and allies. I saw the type when in New York in 1904. The leaf is comparatively broad, with a broad base, approaching the modern *Persicaria amphibia* (*Polygonum amphibium*, L.). There is a strong resemblance to the smaller leaves of *Populus lesquereuxi*.

ARISTOLOCHIACEÆ.

Aristolochia mortua sp. nov.

PLATE VIII, FIG. 25.

Station 14. A leaf, on same slab with *Planera longifolia*.

Leaf evidently thin, similar in form to that of *A. clematitis*, with a more or less acute apex, broadly cordate base, and entire margins. The venation is similar in type to that of *A. crassifolia*. (*A. cordifolia* Newberry, Later Extinct Floras, pl. LX, f. 4 not of Mutis.), but the veins do not unite on the lateral margins. There are about six pairs of lateral veins, diverging at an angle of about 45°, the lowest giving off branches as in *A. crassifolia*. Total length of leaf about 105 mm., breadth about

70. It is more deeply cordate, smaller than and not so broad as in *A. crassifolia*; the margins are much more convex and rounded out than in *A. aurantiaca* (as figured in Zittel).

There is a close resemblance in both form and venation to some species of *Ficus*, such as *F. catalpæfolia* Fzl., but the leaf was evidently thin, and the marginal venation does not agree with *Ficus*.

With regard to the name *A. cordifolia* Mutis, it is to be remarked that while it is so given in Steudel, the 'Index Kewensis' has it "*cordiflora.*" I suspect that the latter name is a mistake, but cannot now consult the original work of Mutis. In any event, the name *crassifolia* (*Catalpa crassifolia* Newb.) has page-priority over *cordifolia* Newberry.

BERBERIDACEÆ.

Odostemon florissantensis sp. nov.

Station 14. Lateral leaflets resembling those of *Odostemon simplex* (*Berberis simplex* Newberry, Later Extinct Floras, pl. lvi, f. 2) from the Miocene of Bridge Creek, Oregon, but the inferior basal angle is produced into a tooth, so that the truncate base of the leaf is greatly broadened. The teeth, as in *O. simplex*, are three on each side, not counting the base. Length of leaf along midrib 42 mm.; extreme length 48 mm.; breadth of the oblique base 25 mm.; length of the tooth-like lobes about 8 mm. The venation, very well preserved, agrees with that of the recent *Odostemon repens* (*Berberis repens* Lindley), but that has many more teeth, which are strongly spinose. Perhaps the greatest affinity is with the Californian species *Odostemon dictyota* (*Berberis dictyota* Jopson). I follow Rydberg in recognizing the genus *Odostemon*, which seems quite sufficiently distinct from *Berberis*.

A smaller and less well preserved leaf is from the same place as the type.

LAURACEÆ.

Persea coloradica sp. nov.

PLATE II, FIGS. 12, 13.

Station 14. Leaf about 76 mm. long, and 19 broad, with entire margins. Lanceolate, with the base practically equilateral, midrib strong, especially basally, where it continues into the thick (2 mm. diam.) petiole; secondaries arched, leaving the midrib at an angle of nearly 70°, but not at all prominent. Not unlike *Laurus princeps*, but much smaller, with the sides a little less parallel.

Another specimen, from Station 11, is about 67 mm. long and 23 broad; it is thus noticeably broader than the type, but it appears to be certainly conspecific.

SAXIFRAGACEÆ.

Saxifraga (?) **peritula** sp. nov.

PLATE X, FIG. 41.

Station 14. Leaf oblique-oval, the base being inequilateral, broadly rounded on one side, slightly concave for about 4 mm. on the other; petiole about 1 mm. diameter, not winged; apex only slightly pointed; margin with regular triangular teeth, sharp but with a broad base, 4 to 4½ in 5 mm.; no venation visible.

This puzzling little leaf is doubtfully referred to *Saxifraga*, because it appears to have been thick and perhaps rather succulent, with weak venation of a character which would be readily obliterated; and the marginal teeth are also exactly as in certain species of that genus.

HYDRANGEACEÆ.

Philadelphus palæophilus sp. nov.

PLATE X, FIG. 37.

Station 13. Leaf ovate-elliptic, similar to that of *P. coronarius* L., about 48 mm. long and 25 broad, sparingly dentate beyond the middle; venation as in *P. inodorus* L., with a pair of prominent laterals arising opposite each other near the base, giving the leaf a trinerved aspect; other laterals few, with few nervilles.

The leaf resembles certain of the narrower ones ascribed by Lesquereux to *Populus arctica* Heer; it also recalls species of *Cinnamomum.* The smaller angles formed by the laterals (especially the upper ones) will distinguish it from *Celtis mccoshii* Lx.

Hydrangea (?) **subincerta**, sp. nov.

PLATE IX, FIG. 32.

Station 14 (W. P. Cockerell). Sterile flower, with 4-lobed calyx, in the manner of *H. radiata*, Walt. Lobes long-oval, about 5½ mm. long, and 3½ broad, as preserved ferruginous brown with light mottling; no conspicuous venation. Total diameter about 13 mm. The lobes as not quite equal in size.

This may not belong to *Hydrangea*, but it accords with that genus in superficial appearance, at least. It is not at all similar to *H. bendirei* (Ward) Knowlton, from Oregon: it recalls rather certain of the recent species, as *H. hortensis.*

GROSSULARIACEÆ.

Ribes protomelænum sp. nov.

PLATE II, FIG. 15.

Station 6 S D; a leaf with its reverse. Leaf about 46 mm. long (apex to beginning of petiole) and fully 60 broad; base deeply cordate, the sides of the basal portion rounded, without lobes; the large lateral lobes as in *R. nigrum*, as also the apical part; margin crenulate-dentate; venation normal. This appears to be quite close to the living *R. nigrum* and *R. hudsonianum.*

CUNONIACEÆ.

Weinmannia phenacophylla sp. nov.

Station 13. Leaflets narrow, about 27 mm. long and 6–6½ broad, coarsely crenate-dentate on the upper edge; wings abruptly enlarged beneath the insertion of the leaflets.

This is the species figured by Lesquereux, Cret. and Tert. Floras, pl. xlii, as *W. haydenii* (*Rhus haydenii* Lx.), but the true *haydenii* is the plant figured on the same plate as *W. integrifolia,* especially fig. 10.

Weinmannia haydenii (*Lx.*). *Weinmannia integrifolia* Lx.; *Rhus haydenii* Lx.

The British Museum collection, now in my hands, contains an excellent specimen of this species, very like that figured by Lesquereux (Tertiary Flora, pl. lviii, f. 12), but rather more perfect, and with the second pair of leaflets (counting from the apex) strictly opposite. It was obtained at Florissant by the Princeton expedition of 1877; the locality "Middle Park," cited by Lesquereux, is erroneous. The leaflets are entire, and the plant seems distinct from *W. phenacophylla,* but it is not impossible that the latter may eventually be found to deserve only varietal rank.

Weinmannia obtusifolia *Lx.* Station 13. A very characteristic specimen.

Weinmannia lesquereuxi sp. nov.

Station 14. Type in Amer. Mus. Nat. Hist.; reverse at Univ. of Colorado. Leaflets about 31 mm. long and 11 broad, the apex acuminate, the upper edge coarsely serrate-dentate with five or six teeth, the lower edge serrate with two or three teeth beyond the middle. The leaflets are larger, further apart (15–16 mm.) and much more coarsely serrate than in *W. phenacophylla*; they are fully twice as broad, though little longer. The wings are similar to those of *phenacophylla,* but broader.

No doubt it is this species which Lesquereux figures (Cret. and Tert.

Floras, pl. xlii, figs. 15, 16, 17) as *Rhus acuminata* Lx. The original *Rhus acuminata* Lx., 1872 from Green River, must be considered doubtful. The name *acuminata* was much earlier used in *Rhus* by DeCandolle. Another specimen of *W. lesquereuxi* was found at Station 13 (W. P. Cockerell). It exhibits six pairs of leaflets, the distance from the first to the last about 118 mm. The terminal leaflet is 13 mm. broad; the leaflets of the second pair from the end are 43 mm. long. As in the type, the leaflets are sessile.

A single leaflet of *W. lesquereuxi*, obtained by the Princeton Expedition of 1877, is in the British Museum (No. V. 2784). It is labelled *Rhus incisa* Heer.

Weinmannia (?) **dubiosa** n. n.

Weinmannia rosæfolia Lx., 1874; not A. Cunn. 1839.
Rhus rosæfolia Lx., 1878; not Hoffmsgg.

This may remain in *Weinmannia*, as it resembles one of the New Zealand species (*W. sylvicola*), and does not appear to be a *Rhus*.

HAMAMELIDACEÆ.

Liquidambar convexum sp. nov.

PLATE VII, FIG. 16.

Station 14 (*S. A. Rohwer*). A leaf, with reverse.

Leaf large, the blade at least 10 cm. long; middle lobe about 7 cm. long (the apex is missing), and 36 mm. broad in the middle, but only 26 at base, its sides being strongly convex; second lobes much more slender, the greatest width about 22 mm., the apex tapering; serrations rather feeble and obtuse, about four in 10 mm.

Apparently distinct by the convex margins of the lobes; perhaps nearer to the living *L. styraciflua* than to the fossil *L. europæum*, though the tapering tips suggest the latter, as figured by Heer from Œningen.

ROSACEÆ.

Rosa wilmattæ sp. nov.

PLATE VII, FIG. 14.

Type in Am. Mus. Nat. Hist.

A species of the *R. sayi* type, the leaves with five leaflets; stipules very narrow, not apparent in the fossil; leaf 55 mm. long, of which 21 mm. is petiole; first pair of leaflets small, oval, 10 mm. long, about 6½ broad, nearly sessile; second pair about 7½ mm. from first pair, long-oval, about 16 mm. long and 7½ broad; apical leaflet 5 mm. beyond second pair, long-oval, with a cuneate base, length 21 mm., breadth 10; serrations of leaflets coarse and simple.

Another specimen (in Univ. of Colo.) has larger and broader leaflets; the second pair about 10½ mm. broad.

The other American Tertiary rose (also from Florissant), *R. hilliæ* Lx., represents the modern *R. setigera,* and has only three leaflets, and very distinct stipules. *R. wilmattæ* has a slight superficial resemblance to *Weinmannia rosæfolia* Lx. This latter species was later referred by Lesquereux to *Rhus,* but it may as well remain in *Weinmannia,* on account of its resemblance to the New Zealand *W. sylvicola.* If retained in *Rhus,* the name would have to be changed, having been earlier used in that genus.

MALACEÆ.

Amelanchier peritula sp. nov.

PLATE VI, FIG. 6.

Station 13 (T. D. A. Cockerell). A single well-preserved leaf, coffee brown in color. Broad oval, the apex and base forming about equal angles (of about 100°); marginal teeth broad and not sharp, about 12 in number on each side, extending to within about 5 mm. of the base; the largest (upper) teeth are about three in 6 mm.; principal lateral veins 3½–4 mm. apart. Length of leaf about 26 mm., breadth about 17½.

Differs from *A. scudderi* Ckll., by its narrower form, with the serrations much more numerous, and beginning near the base. It is a little like the living *A. rotundifolia* (Mx.), but is much narrower, with fewer lateral veins. It has no resemblance to *A. typica* Lx.

A. scudderi Ckll. is from the railroad cut east of Florissant.

Cratægus (?) **lesquereuxi** Ckll. (*Cratægus acerifolia* Lx.) Station 14. A good leaf, lacking the base, but having the long pointed apex, wanting in Lesquereux's type. I do not think the plant is a *Cratægus*; it looks to me like some member of the Malvaceæ, perhaps *Althæa.*

The following species is also recorded from Florissant:

Cratægus newberryi n. n. *Cratægus flavescens* Newberry (not of Bosc, in DC.); *Myrica diversifolia* Lx., not *Cratægus diversifolia* Steud.

Sorbus megaphylla sp. nov.

PLATE IX, FIG. 29.

Station 14. The end of a leaf, with six leaflets preserved.

Leaf large, the leaflets narrow and elongated, those of third pair from end about 70 mm. long and 12½ wide, with only a few coarse distant teeth near the middle; distance between second and third pair of leaflets (from end) 15 mm.; apical leaflets about 56 mm. long and 10½ wide.

This looks at first sight like a *Rhus*, but the leaflets are rounded (not tapering) at the base, a character which accords better with *Sorbus*. In any case, the plant is quite distinct from *Rhus coriarioides* Lx., by the rounded bases of the leaflets and their almost straight lower edge.

AMYGDALACEÆ.

Amygdalus gracilis *Lx.*

MIMOSACEÆ.

Leucæna coloradensis sp. nov.

Legume similar in form to that of *L. greggii* Watson, about 75 mm. long, 7 broad, the margins even, both ends tapering. The pod is only slightly curved. Station 7 (*S. Rohwer*).

With this I associate a fragment of a leaf from Station 13, apparently identical with Lesquereux's Cret. and Tert. Flora, pl. xxxvii, f. 13, referred there to *Mimosites linearifolius*; but my leaf is certainly different from that originally described under that name, as the leaflets are only 9 mm. long, and scarcely 1½ broad, while there are five leaflets on each side in 10 mm. (7 in 25 mm. in *linearifolius*). The leaflets are sessile, with a truncate or subtruncate base, and parallel sides. The midrib is not distinctly visible. The pinnæ have more than 20 pairs of leaflets. The leaf (pinna) has a strong superficial resemblance to a branchlet of *Taxodium*.

The genus *Mimosites* was founded by Bowerbank in 1840 on a fruit (legume) from the cement-stone of Ossington, Suffolk, England. This fruit, according to Unger, is very like that of *Acacia farnesiana*, and there is no particular reason for supposing it congeneric with the so-called *Mimosites* of Florissant. The name *Mimosites*, however, has been applied in a general sense to fossil plants resembling *Mimosa* or *Acacia*.

The following table separates the Florissant Leguminosæ recorded by Lesquereux:—

Leaves bipinnate, leaflets entire . . *Mimosites linearis* (Lx.) Knowlton.
Leaves not bipinnate . . . . 1.
1. Leaves broad, nearly circular or obtusely subtriangular, entire *Cercis parvifolia* Lx.
Leaflets ovate-lanceolate, acuminate (compare the modern *Cassia occidentalis*) *Cassia fischeri* Heer, Lx.
Leaflets long-cordiform, deeply emarginate at apex, margins entire (compare the modern *Dalbergia melanoxylon*) . . . . *Dalbergia cuneifolia* Heer, Lx.
Leaflets lanceolate . . . . 2.

2. Leaves trifoliate, leaflets serrulate (compare *Melilotus*) *Leguminosites serrulatus* Lx.
   Leaflets entire . . . . 3.
3. Leaves trifoliate . . . . 4.
   Leaves presumably pinnate . . . . 5.
4. Lateral leaflets equilateral at base . . . . *Cytisus modestus* Lx.
   Lateral leaflets very inequilateral at base . . *Cytisus florissantianus* Lx.
5. Leaflet broadest beyond the middle, lateral veins nearly parallel with midrib *Acacia septentrionalis* Lx.
   Leaflet broadest in middle or below, lateral veins subtransverse *Podogonium acuminatum* Lx.

The evidence for the existence of the beautiful genus *Podogonium* at Florissant is at present somewhat inadequate, but certainly the leaflet figured by Lesquereux might almost belong to *P. knorii* (A. Br.), from Œningen.[1] Lesquereux also refers to a fragment of a seed. The generic position of the fossil *Dalbergia* is a little doubtful; notwithstanding the great superficial resemblance to the modern *D. melanoxylon*, the venation is not quite the same. The species referred to *Cytisus* cannot be supposed to belong to that genus. They are discussed below under the head of *Ptelea.*

Viborquia *Ortega.*

Viborquia Ortega, Hort Matr. Dec. 66 (1798) = *Eysenhardtia* H. B. K., 1823.

The prior name for this genus has been suppressed, I suppose because of the still earlier *Viborgia* Moench, 1794; a synonym of *Cytisus.* It appears to me that the names are quite distinct, and so I adopt the earlier one. The known living species are few, as follows:

(1.) *Viborquia polystachya* Ortega = *Eysenhardtia amorphoides* H. B. K. Mexico and southwestern U. S.

(2.) *Viborquia spinosa* = *Eysenhardtia spinosa* Engelm. 1850. Texas and northern Mexico.

(3.) *Viborquia orthocarpa* = *Eysenhardtia orthocarpa* (A. Gray) Watson Mexico and New Mexico.

(4.) *Viborquia adenostylis* = *Eysenhardtia adenostylis* Baill., 1870. Guatemala.

To these must be added a fifth species, from the Miocene shales of Florissant:—

Viborquia nigrostipellata sp. nov.

Represented by a portion of a leaf, about 26 mm. long, rachis straight and very slender, still bearing four long-oval leaflets, three on one side and one on the other;

---

[1] There is a superficial resemblance, at least, between *Podogonium* and our *Gleditsia aquatica* Marsh, of the Southern States.

these leaflets with the blade about 5⅓ mm. long and 2⅖ broad, with petiolule about ⅔ mm., the whole almost exactly as in the living *V. orthocarpa.* The little pairs of sharply pointed stipels are black, and except that they are a little broader and shorter, exactly resemble those of *V. spinosa.* The distance from the insertion of one pair of leaflets to another is 3 mm. Florissant (*Princeton Expedition*); type in the British Museum (No. V. 2579).

RUTACEÆ.

Fagara (?) **delicatula** sp. nov.

Station 14 (W. P. Cockerell). Type in Amer. Mus. Nat. Hist.; reverse at Univ. of Colorado. A single well-preserved leaf.

Leaf about 63 mm. long, of which 20 mm. is petiole; five pairs of leaflets, and a terminal one, the leaflets of the pairs opposite; leaflets lanceolate, entire, apparently very thin; leaflet of second pair from base about 23 mm. long and nearly 7 broad, with a very short petiole; leaflets of last pair about 10 mm. long, and apical leaflet also narrow.

Very distinct from *Fagara spireæfolia* (*Zanthoxylum spireæfolium* Lx., 1883), described from Florissant, by the much narrower leaflets. In both the leaflets are symmetrical at the base, differently from the common modern species. A third species, *Fagara diversifolia* (*Zanthoxylum diversifolium* Lx. 1878), is recorded from the Miocene of California.

Ptelea modesta (sp. nov.?).

Station 14 (W. P. Cockerell). A branch with three leaves; leaves trifoliate, with three sessile lanceolate-acuminate leaflets, the largest 10 mm. broad and over 40 long, their margins sparingly serrate, the serrations sharply pointed. This appears to be the *Cytisus modestus* and *Leguminosites serrulatus* of Lesquereux (Cret. and Tert. Floras), the *Cytisus* having priority of place.

The smaller leaves agree exactly with the *Cytisus*, the larger with the *Leguminosites*, and it cannot well be doubted that they and the plant before me all represent a single species, which appears to be a *Ptelea.* I will also venture to suggest that the supposed fruit of *Dodonæa* figured in Cret. and Tert. Floras, pl. xxxvi, f. 5, may belong to *Ptelea modesta.*

The *Cytisus florissantianus* Lx. is no doubt really leguminous; it may belong to *Rhynchosia.*

MELIACEÆ.

Melia (?) **expulsa** sp. nov.

Station 14. Type in Amer. Mus. Nat. Hist.; reverse at University of Colorado. Apparently similar to *M. azedarach* L., though smaller, with the terminal leaflets more decidedly though very irregularly lobed, and its basal part very slender; length of terminal leaflets about 35 mm., its breadth about 12, with two large lobes on each side; lateral leaflets next to the terminal one about 23 mm. long, slender basally, but sessile; leaflets opposite.

Melia is an Asiatic genus; *M. azedarach* can endure a temperate climate, and is commonly planted by roadsides in southern New Mexico. The fossil may not belong here, but the general resemblance is very close, and I do not know where else it can be placed.

ANACARDIACEÆ.

Rhua hilliæ *Lx.* Station 14, common. Also in the British Museum, No. 11043. The leaves are compound and odd-pinnate, as Lesquereux surmised; the leaflets are very variable; the broader and shorter ones are suggestive of *Cratægus.* One occurs on the same slab as *Tmesipteris alleni.*

Cotinus fraterna (*Lx.*) *Ckll.* This was obtained in excellent condition at Station 14. Also found at Station 11.

For *Rhus acuminata* Lx. and *R. rosæfolia* Lx., see *Weinmannia.*

The Florissant species of this family may be separated thus:—

Leaves oval, pointed at each end, entire, long-petioled *Cotinus fraterna* (Lx.) Ckll.
Leaves trifoliate . . . . 1.
Leaves pinnate . . . . 2.
Structure of leaves uncertain, but leaflets subovate, acuminate, with one or two pointed lobes or very large teeth on each side . *Rhus subrhomboidalis* Lx.
Leaflets ovate-acuminate, denticulate (probably not at Florissant) *Rhus evansii* Lx.
1. Leaves long-petioled, leaflets cuneiform, lobed, not acuminate *Schmaltzia vexans* (Lx.) Ckll.
Leaflets long-ovate, entire, apical one much larger than the lateral ones *Rhus cassioides* Lx.
Leaflets orbiculate . . . . *Rhus rotundifolia* Kirch.
Leaflets oval, apiculate and dentate to middle . . *R. trifolioides* Lx.
2. Leaflets lanceolate, serrate (like *Rhus hirta*) . . . *R. corarioides* Lx.
Leaflets ovate-acuminate, coarsely and irregularly serrate, or lobed *R. hilliæ* Lx.

Of all these, only *R. coriarioides* is a perfectly typical *Rhus* in the restricted sense.

AQUIFOLIACEÆ.

Ilex knightiæfolia *Lx.* Station 14, not rare. The leaves are variable in size. *I. rigida* Kirch. appears to be a synonym. The leaves are parallel-sided, with large teeth, and remind one of the dandelion.

Ilex leonis *Ckll.* V. 2584, in the British Museum, is a sparsely denticulate leaf of this species. *Ilex microphylla* Lx. is not figured, but it is said to very closely resemble *Ilex subambigua* (*Ilex ambigua* Unger, Chloris Protogæa, 1847, not of Elliott, 1824, or Torrey, 1843). Unger's figure shows a species not unlike *I. leonis*, and I strongly suspect that *I. microphylla* Lx. is only a small leaf of *leonis*. The name *microphylla* is not available for the Florissant species, having been much earlier used by Hooker and Sprengel.

Ilex subdenticulata *Lx.* A rather ambiguous species; Lesquereux's figures 5 and 6 do not appear to be conspecific.

Ilex grandifolia *Lx.* Based on a fragment of a very large leaf, 5 cm. broad, the margins dentate.

Ilex pseudostenophylla *Lx.* Not figured. Leaf small, obovate or oblanceolate, obtuse, entire. It is said to be like *I. stenophylla* Unger, and is therefore of the type of the modern *Ilex cassine* L.

CELASTRACEÆ.

Pachistima (?) **integra** sp. nov.

PLATE VIII, FIG. 27.

Station 14 (S. A. Rohwer). A piece of a twig with six leaves, which as preserved are dark brown. The opposite leaves with parallel margins are entirely as in *P. canbyi*, but the petioles are a little longer (2–3 mm.), and the margins of the leaves are entire. Length of blade 25 mm.; breadth about 6½; distance from one pair of leaves to next about 4 mm.

The Florissant Celastraceæ may be separated thus:—

Margins of leaves entire . . . . 1.
Margins of leaves crenate, serrate or dentate . . . . 2.
1. Leaves long and narrow, with parallel sides . . *Pachistima integra* Ckll.
Leaves small, broadly oval, obtuse, abruptly narrowed to petiole *Celastrus greithianus* Heer, Lx.
2. Leaves orbicular or suborbicular, crenate . . . *Celastrinites elegans* Lx.
Leaves obovate or spatulate, rounded and dentate at apex *Celastrus lacoei* Lx.
Leaves broad lanceolate, serrate, decurrent to petiole . *C. fraxinifolius* Lx.

The two leaves figured by Lesquereux as *Celastrinites elegans* appear to be doubtfully conspecific, and they so little resemble Saporta's various species of this genus that their generic position may well be considered uncertain. In true *Celastrinites* the margins are not crenate, but undulate to short-toothed, the points being usually more or less sharp, and the broad sinuses between them gently and evenly concave. This just reverses the condition found in *C. elegans*.

STAPHYLEACEÆ.

Staphylea acuminata *Lx.* Station 14, Station 11 (*W. P. Cockerell*) and Station 5). The last mentioned locality is the *Corixa*-zone in the railroad cut east of Florissant station. There appears to be no reason for questioning the generic reference, although the genus is not otherwise known from the American tertiaries. The locality "Middle Park" is erroneous; all the material described by Lesquereux came from Florissant. (*Cf.* Whitman Cross, Proc. Colorado Scientific Soc., Oct. 1892, pp. 21–24.)

ACERACEÆ.

Acer florissanti *Kirch.* was found at Stations 5 and 13. A fruit, supposed to be *A. mysticum* Kirch. is from Station 11.

SAPINDACEÆ.

Sapindus stellariæfolius *Lx.* Station 14 (W. P. Cockerell); also in the British Museum, from the Princeton Expedition of 1877. The latter specimen shows the terminal leaflet, which is 28½ mm. long, and nearly 7 broad, similar to the lateral ones, but equilateral. These specimens belong to Lesquereux's smaller form of *S. angustifolius* (*e. g.*, Cret. and Tert. Fl., pl. xxxvii, f. 4), but they appear to me to be conspecific with *S. stellariæfolius*, and the name *angustifolius* was much earlier used in *Sapindus* by Wallich. The large leaflets which Lesquereux refers to *S. angustifolius* belong to a different plant, described below.

Sapindus coloradensis sp. nov.

PLATE IV, FIG. 31.

Station 14 (W. P. Cockerell). A beautifully-preserved specimen, ferruginous in color, the leaves very distinct, but the secondary venation practically obsolete. Closely allied to *S. drummondi* Hook. & Arn., of our Southern States, but the leaflets are hardly so broad in proportion to their length. Leaflets in 9 pairs (no odd terminal one), inequilateral as usual in the genus, entire, acuminate, about 47 mm. long and 12 broad, the apical pair broader and shorter, with the broadest part near the middle instead of at the base; the leaflets are very short-petiolulate. Length of rachis 123 mm.; leaflets usually but not always opposite.

This is part of Lesquereux's *S. angustifolius* (not Blume, not Wall); *e. g.*, his fig. 3, pl. xxxvii, in Cret. and Tert. Floras, and fig. 2 in Tertiary Flora, pl. xlix.

Sapindus leonis sp. nov.

I had supposed that all the large leaves referred by Lesquereux to *Sapindus angustifolius* might be placed with *S. coloradensis* Ckll., the type of which is a very beautiful specimen figured herewith. I find, however, in the British Museum collection a very good leaf, on which five leaflets still remain, agreeing with Lesquereux's Pl. XXXVII, fig. 7, in the "Cretaceous and Tertiary Floras." This was obtained by the Princeton Expedition, and is numbered V. 2569; it may be taken as the type of a species *S. leonis*, described as follows:—

Leaflets opposite, sessile or practically so, lanceolate, entire, with the base gibbous at one side, even perhaps a little more than is shown in Lesquereux's figure just cited. Length of leaflets about 64 mm., breadth near base 15 mm., breadth about 30 mm. from tip 12 mm., 15 mm. from tip 7½ mm.; insertions of pairs of leaflets 19 mm. apart. Venation as in figure cited.

From *S. coloradensis* this is readily known by the larger leaflets, which are sessile, and taper much more gradually.

Lesquereux describes two other species from Florissant; *S. inflexus* Lx. and *S. lancifolius* Lx.

RHAMNACEÆ.

Leaf orbicular . . *Paliurus* **haydeni** n. n. (*P. orbiculatus* Lx., not Saporta.)
Leaf ovate . . . . *Zizyphus obtusa* Kirch.
Leaf lanceolate or broad-lanceolate . . . . 1.
1. Leaf small, broadest below the middle, with lateral nervures arising near the base, and running parallel to the margin (*Z. obtusa* has similar laterals) *Paliurus florissanti* Lx.
Leaf larger, narrower basally; margin entire . . . . 2.
2. Leaf broader and shorter . . . . . . *Rhamnus kirchneri* Ckll.
Leaf longer and narrower *Rhamnus florissantensis* n. n. (*R. oleæfolius* Lx., not *oleifolia* Hook.)

The venation of *Paliurus* is much like that of *Ceanothus*; *P. haydeni* is curiously similar to some of the leaves referred to varieties of *Populus arctica*. I separate *P. haydeni* from *P. orbiculatus*, as the latter (European) species has the leaf less precisely orbicular, with the base subemarginate instead of truncate. *Rhamnus kirchneri* may be compared with *R. frangula*, but the leaves are hardly so broad. *R. florissantensis* is like *R. caroliniana*, but that has the margins usually more or less serrate.

VITACEÆ.

Vitis florissantella sp. nov.

PLATE VII, FIG. 18.

Station 13 (W. P. Cockerell). Type in Amer. Mus. Nat. Hist.

Leaf small, of the general type of *V. vinifera*. Length about 27 mm. (apex wanting, length of leaf as preserved 22 mm.); breadth about 26; trilobate, the apical lobe broad-ovate, separated from the lateral lobes by broad claviform sinuses, about 7 mm. deep; base strongly cordate, with a sinus about 4 mm. deep; serrations coarse, about 2½ mm. long, not sharply pointed; three principal veins, one to each lobe.

When working out this species, I took occasion to review the fossil American species referred to *Vitis*, with the following result:—

(1.) The four species described by Ward in Bull. 37, U. S. Geol. Surv., belong to *Ampelopsis*. This agrees with Ward's own opinion; he did not consider *Ampelopsis* a distinct genus, and hence used the name *Vitis*. They are separated as follows:—

Leaves large, over 70 mm. long.
  Apical projection sharply pointed, longer than a serration; serrations stronger . . . . *Ampelopsis bruneri* (Ward).
  Apical projection no more prominent than a lateral serration; serrations weaker . . . . *Ampelopsis bruneri carbonensis* (Ward).
Leaves small, less than 40 mm. long.
  Base truncate . . . . . . *A. xantholithensis* (Ward).
  Base tapering to petiole; serrations sharp *A. montanensis* Ckll. (*Vitis cuspidata* Ward).

The non-cordate base readily separates all these from the Florissant plants.

(2.) *Vitis olriki*, Heer, Lx., is a true *Vitis*; a large leaf, of the general type of *V. cinerea*, Engelm., without lateral sinuses. The last character and the size separate it at once from *V. florissantella*.

(3.) *V. sparsa* Lx. is based on seeds, from a place where leaves of *Cissus tricuspidata* (Heer) Lx. are abundant.

(4.) *Vitis* **alaskana** n. n. (*V. rotundifolia*, Newberry, 1882, not of Mx., 1803), from Alaska, is three-nerved, cordate at base, with no lateral sinuses. It is similar in general to *V. rupestris*.

Parthenocissus osborni sp. nov.

Station 14 (W. M. Wheeler). A single leaflet, about 75 mm. long (without petiole) and 28 broad, the apex long-acuminate, the margin with large teeth, all formed practically as in the modern Virginia Creeper.

It is named *P. osborni* because, except for the larger and sharper teeth, it is exceedingly like the *Quercus osborni* Lx., as figured in Cret. and Tert. Floras, pl. xxxviii. It does not look at all like a *Quercus*, and I am by no means prepared to assume that Lesquereux's plant is identical with mine; but in view of the possibility, I provide mine with a name which can remain whether it is the same or not.

TILIACEÆ.

Tilia populifolia *Lx.*

STERCULIACEÆ.

Buettneria (?) **perplexans**, sp. nov.

PLATE X, FIG. 39.

Station 14 (Rohwer). Calyx divided nearly to the base into five equal and symmetrical lanceolate lobes, as in *B. catalpifolia.* Lobes about 9½ mm. long and 3 broad, pointed, constricted basally, with a prominent median nervure, from which numerous lateral nervures diverge at an angle of 45 to 50°, the nervures appearing dark on a light ground.

The reference of this to *Buettneria* is necessarily problematical; in some ways it is suggestive of *Sabbatia.* There is a strong superficial resemblance to *Getonia floribunda* (Combretaceæ), but that has three longitudinal nervures of equal strength, instead of only one. There is also some resemblance to *Petræa volubilis* (Verbenaceæ), but that has the ends of the lobes much less pointed.

It may be added that certain fossil leaves referred to *Ficus*, of the *F. haydenii* type, could very well belong to *Buettneria.*

Sterculia rigida *Lx.* Station 11. *S. engleri* Kirch. is doubtfully distinct.

MALVACEÆ.

Malvastrum exhumatum *Ckll.*

ARALIACEÆ.

Hedera marginata Lx. is probably not a true *Hedera*; it is somewhat suggestive of Berberidaceæ. *Aralia dissecta* Lx. is based on a splendid large palmately-lobed leaf, certainly not a true *Aralia*, but of doubtful generic position. It is said to be very close to *A. multifida* Saporta, both being similar to the living *A. elegans*, a cultivated species from New Grenada. Unfortunately, *A. elegans* is not in the Index Kewensis, nor in Bailey's Cyclopædia of Horticulture, or any other work to which I have access. There is a cultivated species *A. elegantissima* Veitch, but that is quite different, and is from the New Hebrides. *A. dissecta* is also strikingly similar to *Cussonia polydrys* Unger, from the European Miocene, but that does not appear to be a genuine *Cussonia.* The plants seem to be related to *Panax*, and it may be impossible to place them generically from the leaves alone.

UMBELLIFERÆ.

Oxypolis destructus sp. nov.

Station 13. A fruiting umbel; when first found nearly perfect, but on thin papery shale, and much injured on the journey home. Umbel small (about 2 cm. diameter). simple; fruit with the outline of an apple, similar to that of *O. rigidus*, but rather broader, length and breadth each about 3½ mm.

ERICACEÆ.

Andromeda scudderiana n. n. (*A. rhomboidalis* Lx., not Vieill.) has rhomboidal leaves, "narrowed downward to a long slender petiole, and equally so upward to an obtuse apex." It is only an *Andromeda* in the old, broad sense.

VACCINIACEÆ.

Vaccinium retigerum Ckll. (*V. reticulatum* "Al. Br.," Lx., not Sm.). Similar to the living *V. ovalifolium* J. E. Smith.

MYRSINACEÆ.

Myrsine laminarum n. n. (*M. latifolia* Lx., not Spreng.) has the leaves broadly oval or nearly round, entire. It is said to be allied to the European *M. antiqua* Unger. These plants are probably not true *Myrsine*.

SAPOTACEÆ.

Bumelia florissanti *Lx.* Broad subovate leaves, with a cuneiform base, and the apex obtuse, or even slightly emarginate. There is a general resemblance to *B. angustifolia* Nuttall, living in Florida and Texas.

EBENACEÆ.

Diospyros princetonia, sp. nov.

PLATE X, FIG. 36.

Leaf about 62 mm. long, and 25½ broad, long-ovate. pointed at each end, quite entire. Secondaries leaving midrib at an angle of about 45°; apex forming an angle of 50° or more, base a little more narrowed.

Differs from *D. copeana* Lx. by the more pointed apex, narrower form, and the maximum breadth about the middle instead of above it. Both apex and base are more pointed than in normal *D. brachysepala*; the basal 20 mm. of the margin of our leaf is not convex, but straight,— even faintly concave. In the base, *D. princetonia* is more like *D. myosotis* Unger, from Radoboj, but that is a proportionately narrower leaf, with a much less convex (in outline) margin, and the acumination of the apex abrupt instead of gradual. Type in British Museum, no. 655 = v. 2783; collected at Florissant by the Princeton Scientific Expedition of 1877. The specimen was examined by Lesquereux in 1879, and marked '*Diospyros.*'

OLEACEÆ.

Fraxinus palæophila sp. nov. (Oleaceæ).

Station 14. A leaf showing five leaflets. Similar to *F. caroliniana* Mill. the Water Ash of our Southern States, but the obscure crenulation of the leaflets coarser, and the lateral leaflets somewhat broader, and strongly inequilateral. The following measurements are in mm.; length of terminal leaflet (apex gone) about 35, its breadth about 16, its base from origin of upper lateral leaflets 22; petioles of lateral leaflets 6; length of upper lateral leaflets about 33, of lower about 25, their breadth 13–14; crenulations occupying about 2 mm.; venation as in the living species.

Eight species of *Fraxinus* have already been reported from Florissant: it seems absurd to add a ninth, but the plant now described agrees with none of them, and it is very probable that they do not all belong to the genus. *F. heerii* and *F. prædicta* have entirely different venation; *F. mespilifolia* has a much more obtuse base to the leaflets, with a short twisted petiole; *F. libbeyi* has large "leaflets" looking like *Ulmus braunii*; *F. myricæfolia* has much narrower leaflets, which are sessile; *F. abbreviata* has short broad leaflets.

Osmanthus præmissa (*Lx.*) *Ckll.* Plate VI, Fig. 7. Station 14. The end of a branch, about 20 cm. long, with 15 or 16 leaves, but no flowers. The leaves are slightly inequilateral (variably so), perfectly entire, and with no discernible secondary nervures. Their petioles are longer than Lesquereux's figure shows. The plant could be mistaken for a willow.

The Florissant Oleaceæ recorded by Lesquereux may be separated thus:

	Leaves simple, lanceolate, entire	*Osmanthus praemissa* (Lx.) Ckll.
	Leaves compound	1.
1.	Leaflets with entire margins	*Fraxinus heerii* Lx.
	Leaflets with margins dentate, denticulate or serrate	2.
2.	Leaflets lanceolate	3.
	Leaflets broader, ovate or oblong	4.

3. Leaflets sessile and opposite, feebly dentate . *Fraxinus* (?) *myricæfolia* Lx.
Leaflets somewhat broader, with lateral veins strongly arched (probably not at Florissant) . . . . *Fraxinus prædicta* Heer, Lx.
4. Apex attenuate (leaves suggesting *Populus lesquereuxi*, but easily separated by the short twisted petiole) . . . . *F. mespilifolia* Lx.
Apex not attenuate . . . . *F. albreviata* Lx.
F. libbeyi is referred to *Ulmus*. *F. brownellii* Lx. has not been figured.

APOCYNACEÆ.

Apocynophyllum scudderi *Lx.* is reported by Kirchner, but needs confirmation.

CONVOLVULACEÆ.

Porana tenuis *Lx.* (Plate I, Fig. 10.) A very good example was found, lacking only one of the sepals. As Lesquereux states, it is closely similar to *P. macrantha*, Ludwig, differing however in the very obtuse, almost truncate sepals. The venation, which is very distinct, is practically as in *P. œningensis* (A. Br.) Heer, and since this latter has been obtained with characteristic fruit, the reference to *Porana* is fortified. It must be said, however, that the venation is entirely different from that of the recent *Porana* (*Dinetus*) *racemosa*, Roxb.

Porana speirii Lx. is also from Florissant.

SCROPHULARIACEÆ.

Mimulus saxorum, sp. nov.

PLATE X, FIG. 47.

Station 4 (T. D. A. Cockerell). A well-preserved calyx, about 18 mm. long and 8 high, formed approximately as in *M. guttatus*, but the middle and lower teeth, like the upper, are long and sharply pointed. Length of upper teeth about 6 mm., of middle about 5, of lower about six. The peduncle, 6½ mm. long, is preserved. There is some indication of a mediolateral longitudinal rib or fold.

The genus is new to the American Tertiaries.

CUCURBITACEÆ.

Sicyos (?) **florissantia** sp. nov.

PLATE X, FIG. 43.

Station 14. A corolla showing two lobes and part of a third, shaped as in *S. angulatus*. The broad lobes, 3 mm. broad and about 3½ long, are characteristic;

their shape is broader than long, were it not for the small apical projection. The venation is not visible. The throat is quite wide, about 3 mm. in diameter.

I am not sure that this is a *Sicyos*, but the resemblance is certainly very close, and it can go in this genus for the present.

Melothria (?) **coloradensis** sp. nov.

PLATE X, FIG. 40.

Station 9 K (W. P. Cockerell). A flower, showing the ovary shaped as usual in the genus, and constricted below the corolla. Corolla large, about 25 mm. diameter, the lobes broad (10½ mm.) but not very long (6–7 mm.), with pointed tip, their margins entire. Length of ovary 15 mm., breadth a little over 6, the broadest part not toward the base.

Except for the larger flowers, this resembles *M. hirsuta*. It is very distinct from *M. pendula*.

COMPOSITÆ.

Aster florissantia sp. nov.

PLATE IX, FIG. 35.

Station 5 J. A well-preserved leaf, dark brown in color.

Blade about 42 mm. long and a little over 25 broad, ovate-acuminate, cordate at base, distinctly but not very strongly dentate; teeth about 3 to 6 mm. long (i. e. from notch to notch); cordate base also dentate; structure throughout essentially as in *A. divaricatus* L., but the teeth feebler; venation as in *divaricatus*, with strongly arched laterals, and enclosed spaces basally.

Carduus florissantensis *Ckll.*

RELATIONSHIPS UNKNOWN.

Phyllites cyclophyllus (Lx.) Hollick.
Carpites gemmaceus Lx.
Carpites milioides Lx.
Carpites pealei Lx.
Antholithes amœnus Lx.
Antholithes obtusilobus Lx.
Phenanthera petalifera Hollick.

POSTSCRIPT.

Jan., 1908.

The collection of 1907 contains good material of *Myrica obscura* Lx., which proves to be a perfectly valid species, probably referable to *Comptonia*. The new material also throws doubt on the affinities of *Onoclea reducta*, which may not be a fern. Some remarkable new species were obtained, as well as many beautiful specimens throwing fresh light on the described species.

EXPLANATION OF PLATES.

PLATE VI.

Fig. 1. *Stipa laminarum* sp. nov. Cotype.
Fig. 2. *Woodwardia florissantia* sp. nov. Type.
Fig. 3. *Stipa laminarum* (germinating).
Fig. 4. *Onoclea reducta* sp. nov. Type.
Fig. 5. *Pinus wheeleri* (cone) sp. nov. Type.
Fig. 6. *Amelanchier peritula* sp. nov. Type.
Fig. 7. *Osmanthus præmissa* (Lx.) Ckll.
Fig. 8. *Juglans* (?) *sepultus* sp. nov. Type.
Fig. 9. *Dryopteris scansa* sp. nov. Type.
Fig. 10. *Porana tenuis.* Lx.
Fig. 11. *Pinus wheeleri* sp. nov. Type.

PLATE VII.

Fig. 12. *Persea coloradica* sp. nov. Type.
Fig. 13. *Persea coloradica* sp. nov.
Fig. 14. *Rosa wilmattæ* sp. nov. Type.
Fig. 15. *Ribes protomelænum* sp. nov. Type.
Fig. 16. *Liquidambar convexum* sp. nov. Type.
Fig. 17. *Quercus lyratiformis* sp. nov. Type.
Fig. 18. *Vitis florissantella* sp. nov. Type.
Fig. 19. *Morus symmetrica* sp. nov. Type.

PLATE VIII.

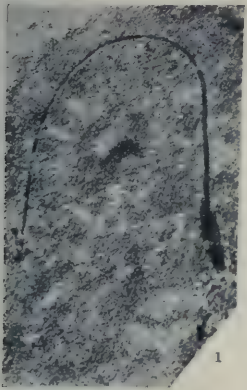
Fig. 20. *Pellæa antiquella* sp. nov. Type.
Fig. 21. *Quercus balaninorum* sp. nov. Type.
Fig. 22. *Populus crassa* (Lx.).
Fig. 23. *Populus lesquereuxi* Ckll. Greatly reduced.
Fig. 24. *Ficus arenaceæformis* sp. nov. Type.
Fig. 25. *Aristolochia mortua* sp. nov. Type.
Fig. 26. *Ulmus tenuinervis* Lx.
Fig. 27. *Pachistima integra* sp. nov. Type.
Fig. 28. *Populus* (?) *pseudocredneria* sp. nov. Type.

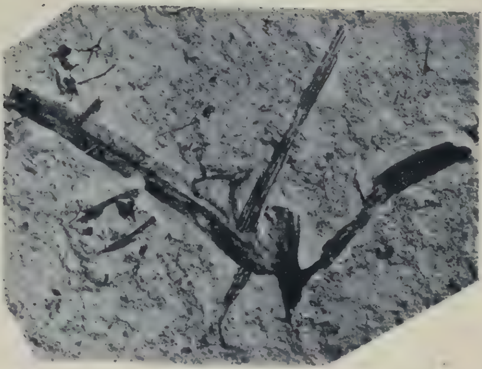
PLATE IX.

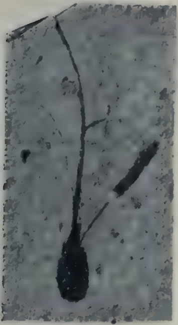
Fig. 29. *Sorbus megaphylla* sp. nov. Type.
Fig. 30. *Planera longifolia* Lx.
Fig. 31. *Sapindus coloradensis* sp. nov. Type.
Fig. 32. *Hydrangea* (?) *subincerta* sp. nov. Type.
Fig. 33. *Ficus florissantella* sp. nov. Type.
Fig. 34. *Salix ramaleyi rohweri* var. nov. Type.
Fig. 35. *Aster florissantia* sp. nov. Type.

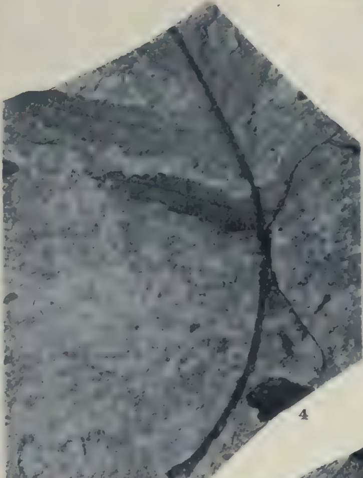
PLATE X.

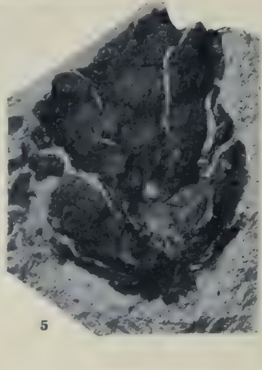
Fig. 36. *Diospyros princetonia* sp. nov. Type.
Fig. 37. *Philadelphus palæophilus* sp. nov. Type.
Fig. 38. *Dryopteris scansa* sp. nov.
Fig. 39. *Buettneria* (?) *perplexans* sp. nov. Type.
Fig. 40. *Melothria* (?) *coloradensis* sp. nov. Type.
Fig. 41. *Saxifraga peritula* sp. nov. Type.
Fig. 42. *Populus crassa* (Lx.).
Fig. 43. *Sicyos* (?) *florissantia* sp. nov. Type.
Fig. 44. *Juncus crassulus* sp. nov.
Fig. 45. *Juncus crassulus* sp. nov. Type.
Fig. 46. *Typha lesquereuxi* Ckll.
Fig. 47. *Mimulus saxorum* sp. nov. Type.
Fig. 48. *Sequoia haydeni* (Lx.) Ckll.

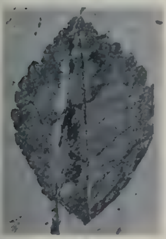

1

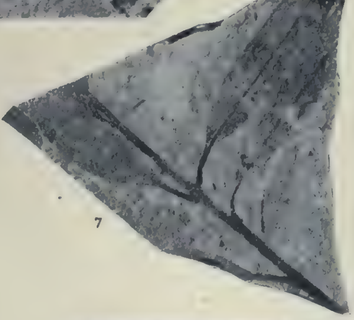

2

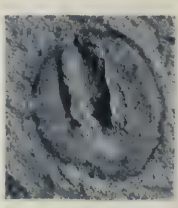

3

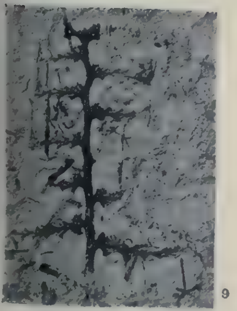

4

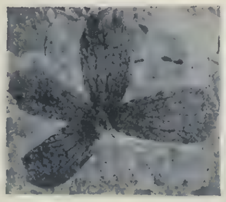

5

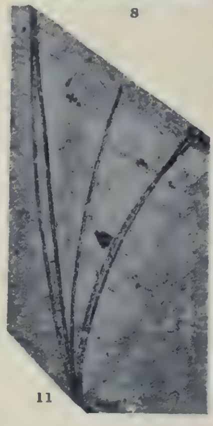

6


7

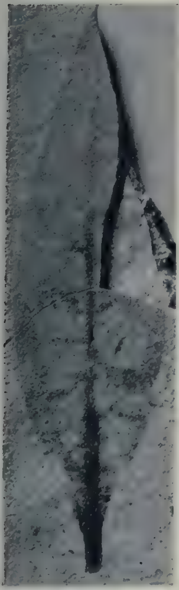

8

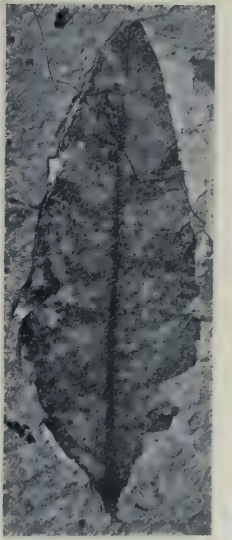

9

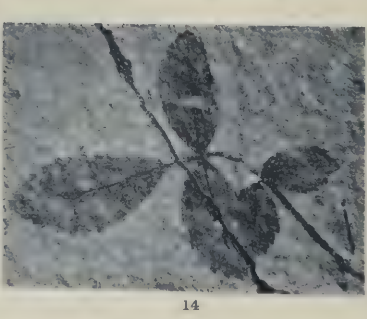

10

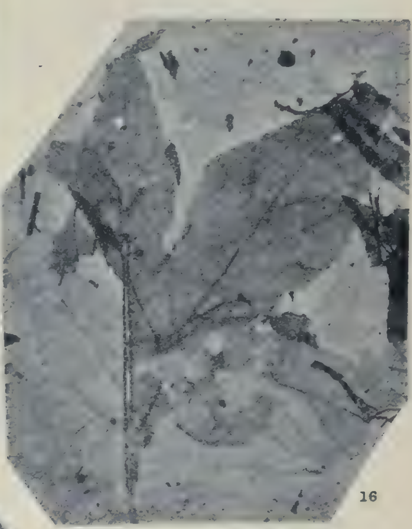

11

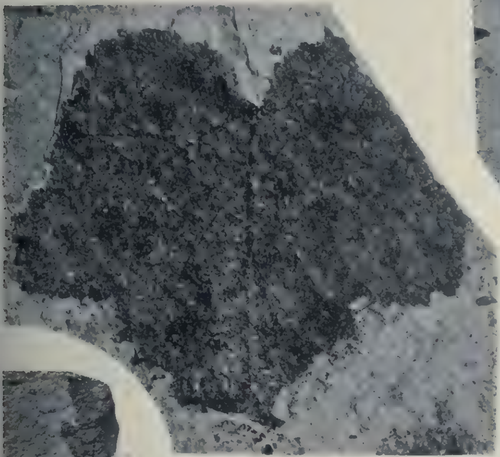
Fossil Plants, Florissant, Col.

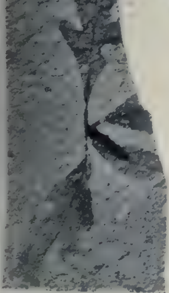

12

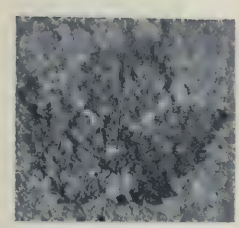

13

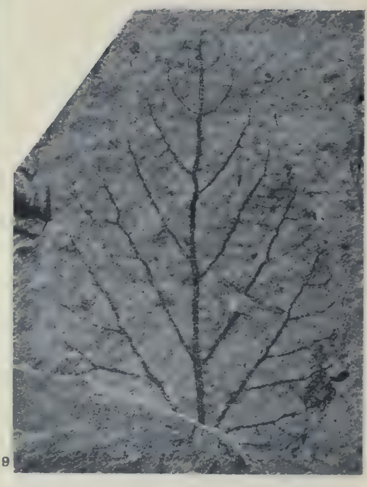

14


16

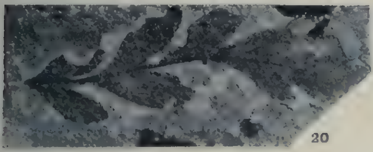

15

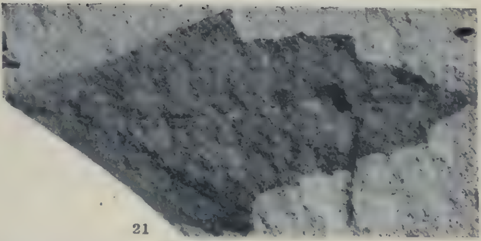

17

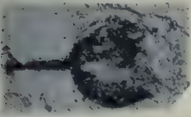

18

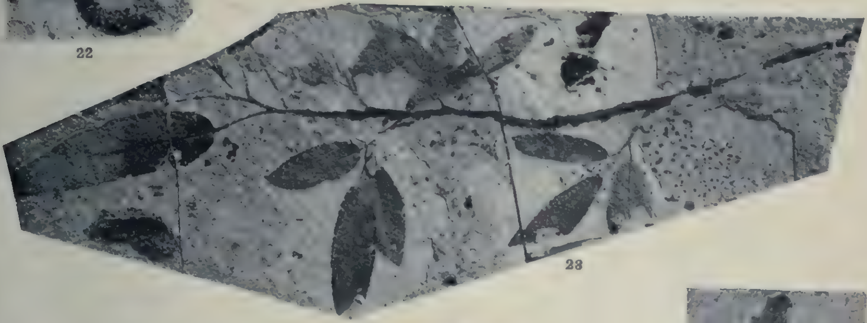

19

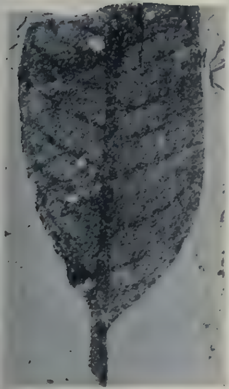
FOSSIL PLANTS, FLORISSANT, COL.

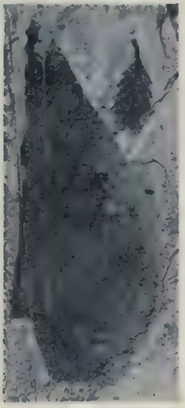

20

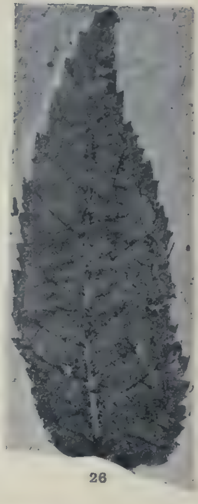

21

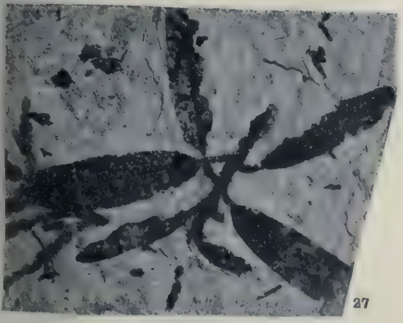

22

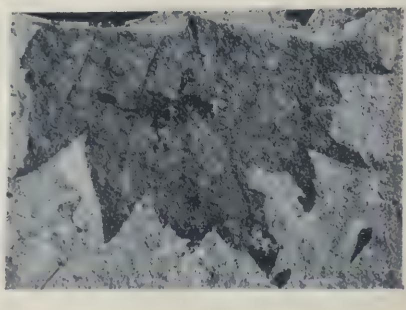

23


24

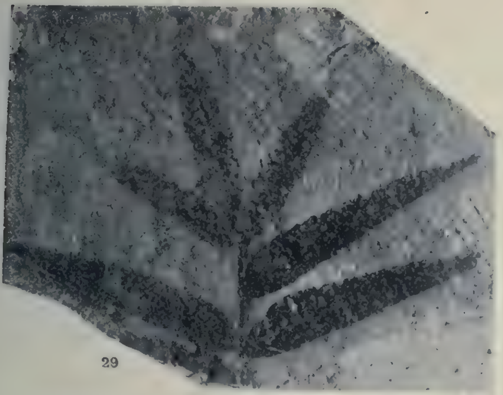

25


26

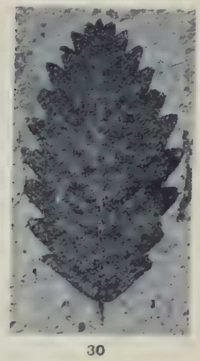

27


28

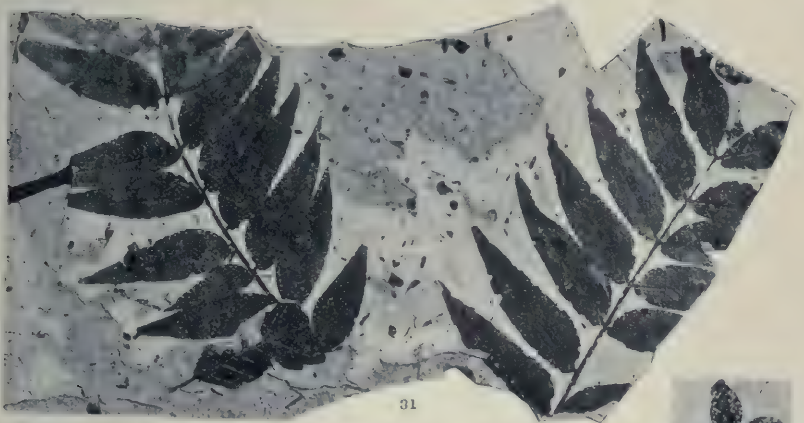
FOSSIL PLANTS, FLORISSANT, COL.



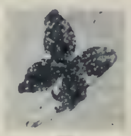
29



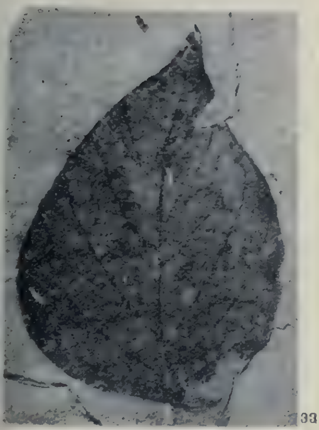
30



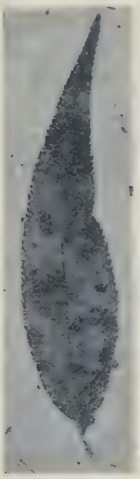
31



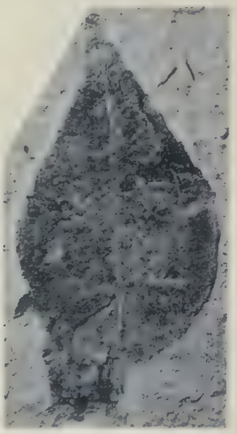
32



33

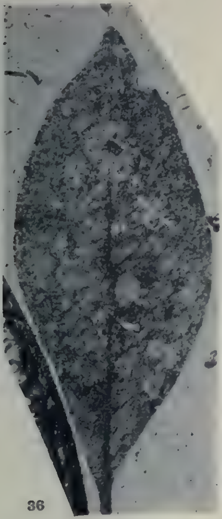


34

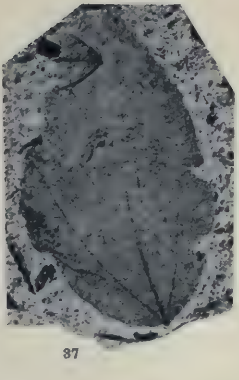


35

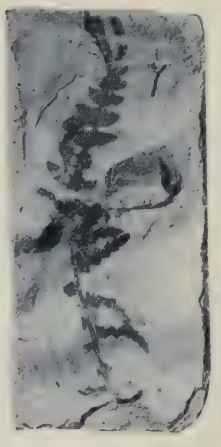
FOSSIL PLANTS, FLORISSANT, COL.



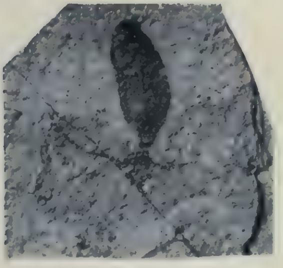
36



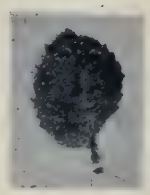
37



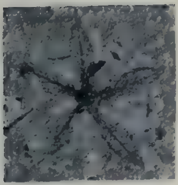
38



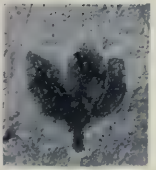
40



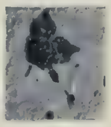
41



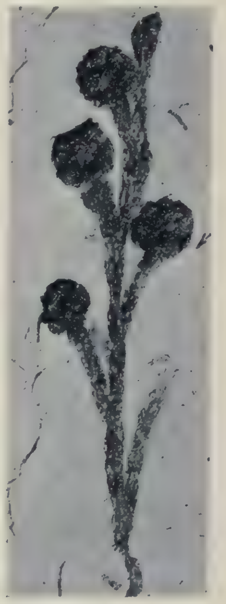
39



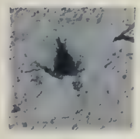
42



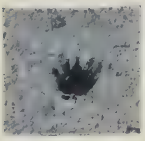
43



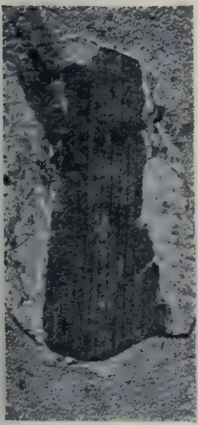
48



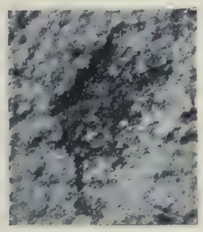
44



45



46



47

FOSSIL PLANTS, FLORISSANT, COL.

59.19(54)

Article V.— PENNANT'S 'INDIAN ZOOLOGY.'

By J. A. Allen.

The story of Pennant's 'Indian Zoology' has been told in outline by A. O. Hume, in 'Stray Feathers' (Vol. VII, 1878, pp. 506–508), but at the time of writing this account he was unable to examine a copy of the work and was thus unable to determine whether or not Pennant gave scientific names to all of his species. A year later Alfred Newton (Stray Feathers, VIII, 1879, pp. 414, 415) supplied this missing information from a copy he found at the British Museum, and gave a list of the species figured and described in the work with the Latin names given them by Pennant. Yet little use appears to have been made of this information by subsequent writers.

The work is of special interest in reference to the first use of the generic name *Otus* in binomial nomenclature,[1] but it also has an important bearing on the nomenclatural history of a number of other species which here for the first time received technical designations. As a copy of this rare work has recently come to light in the Library of the American Museum of Natural History, I have the means at hand to settle various questions of nomenclature dependent upon this little known brochure. Like the copy in the British Museum described by Newton, it lacks the original wrapper, and has no title-page, and in all probability never had any, it being the first fasciculus of a work of which no more was published. The present copy differs from the British Museum copy in having all the plates plain instead of colored. Professor Newton says the British Museum copy is from the "Banksian Library" and bears the book-stamp "Jos. Banks." The copy here under notice belongs to the library of the New York Academy of Sciences, now on deposit at the American Museum, and has, written in ink at the top of the first page, "De Kay Edin 1818," evidently the autograph of the late James E. Dekay, with the place and date of procurement, "Edin" doubtless standing for Edinburgh. On all the plates is stamped, in red ink, "Lyceum of Natural History," and at the bottom of the last page, "Library, N. Y. Academy of Sciences," in blue ink. It bears no other marks.

The library of the American Museum of Natural History has also a copy of Forster's 'Indische Zoologie,' referred to by Hume (*l. c.*), so that direct comparison may be made of the two works, and also with Pennant's "second edition" of his 'Indian Zoology.'

---

[1] *Cf.* Stone, Auk, XX, 1903, pp. 273–275; Allen, Bull. Am. Mus. Nat. Hist., XXIII, 1907, p. 334.

Hume's account of Pennant's work is evidently based on Forster's preface to the 'Indische Zoologie.' From this preface we learn that Gideon Loten, for a time governor of Ceylon for the Dutch East India Company, was an ardent naturalist and a good natural history draftsman, and that during his residence in Ceylon he not only made many drawings of animals himself but also trained some of his native servants to make them, so that when he returned to Europe he brought with him a large collection of colored drawings of Ceylon animals. He resided for some time in England, and showed these drawings to Sir Joseph Banks, who became greatly interested in them, and obtained permission to have some of them copied. An arrangement was also made with Thomas Pennant to have some of them engraved on copper for publication, Loten to furnish the drawings and Pennant the descriptions. This proved very fortunate, as later Loten decided to send the drawings to Holland, and the vessel in which they were shipped was wrecked and all the drawings were lost. Fifteen of the drawings had already been engraved, and twelve had been published, they forming the basis of Pennant's 'Indian Zoology,' here under notice.[1]

This work is printed in English and French, in parallel columns. Forster being in England when Pennant's work was about ready for publication he was asked, he tells us in the preface to his 'Indische Zoologie,' to furnish a French translation of the English text, which he says he undertook very willingly and with great care. As, however, the proofreading was entrusted to incompetent hands, he found the French text full of errors.

On the return of Sir Joseph Banks from his long voyage around the world with Captain Cook, Sir Joseph, in conjunction with Loten and Pennant,[2] presented the copper-plates of the 'Indian Zoology' to Forster, together with the descriptions. These plates and descriptions thus became the basis of Forster's 'Indische Zoologie,' published in Halle twelve years later, Forster translating Pennant's descriptions into German and Latin, "improving and correcting them," as he says, and adding the synonymy. Forster's work is thus also bilingual, and has two title-pages, the first in German, the second in Latin, which accounts for the two methods of citation — 'Ind. Zool.' and 'Zool. Ind.' — so often met with, some writers citing the German, others the Latin title. The two title-pages are as follows:

---

[1] Pennant says, in the preface to his second edition: "This work, or rather fragment, was begun in the year 1769. The descriptive part fell to my share: the expense of the plates was divided between Mr. Banks, now Sir Joseph Banks, *Baronet*; John Gideon Loten, Esq., a governor in *Ceylon*; and myself. Twelve only were engraved and published: soon after which, the undertaking appeared so arduous that the design was given over. . . . I prevailed on my two friends to unite with me in presenting the learned John Reinhold Forster with the plates. I also bestowed on him three others, engraven at my own expense, before the work was dropped. These were never published in *England*; but when Dr. *Forster* left our island, he took the whole with him, and in 1781 printed, at *Halle*, in *Saxony*, an edition very highly improved, and translated into *Latin* and *German*. . . ."

[2] See last part of preceding footnote.

> Indische Zoologie | oder | systematische Beschreibungen | seltener und unbekannter Thiere | aus Indien, | mit 15 illuminirten Kupfertafeln erläutert. | — | Nebst | einer kurtzen vorläufigen Abhandlung | über | den Umfang von Indien und die Beschaffenheit | des Klima, des Bodens und des Meeres daselbst, | und einen Anhange, | darin | ein kurzes Verzeichness der Thiere in Indien | mitgetheilt wird, | herausgegeben | von | Johann Reinhold Forster, | der Rechte, Medizin und Weltweisheit Doctor. | — | Halle, | bey Johann Jacob Gebauer 1781.
>
> Zoologia Indica | selecta | Tabulis XV Aeneis illustrata.| — Praemittitur | de finibus et indole aeris, | soli, marisque indici | brevis lucubratio. | Seqvitur ad calcem | brevis enumeratio Animalium Indiae. | Auctore | Joanne Reinoldo Forster | LL.M. et Ph.D. | — | Halae, | Impensis Joannis Jacobi Gebaveri. | MDCCLXXXI. | — Folio, 4 ll. (= 2 title-pages and dedication), pp. i–iv (preface, in Latin and German), pp. 1–42, pll. i–xii + 3 pll. not numbered, all colored; all but one signed "P. Mazell, Sculp."
>
> The 'Vorläufige Abhandlung' occupies pp. 1–10; the 'Auswahl der Indischen Zoologie,' pp. 11–38; the 'Specimen Faunulae Indicae,' pp. 39–42.

Forster's 'Indische Zoologie' has thus for its basis the original twelve plates of Pennant's 'Indian Zoology,' with three additional plates not previously published,[1] and Pennant's original descriptions, which are not essentially altered in the new translations; but Pennant's proposed account "Of the Bird of Paradise: and the Phoenix," of which only the title is given at the bottom of the last page of Pennant's brochure, is furnished by Forster, being elaborated to great length (pp. 26–38). He also added descriptions of the three new birds and two fishes figured on the new plates.

Pennant's 'Verzeichniss der Thiere von Indien,' entitled: "Specimen Faunulae Indicae. Auctore Thoma Pennant Armigero R. S. S." (pp. 39–42) is a nominal list, the names of the mammals being for the most part without authorities or references to preceding authors and thus *nomina nuda*; the bird names are followed, in many cases, by authorities, or by references to the 'Pl. enl.,' or to the plates of Edwards or Brisson, or to unpublished plates of Loten. Thus many of the names are Linnæan or Brissonian, others are based on Edwards or on the 'Planches enluminées,' etc. Some of the latter antedate names given by Boddaert (1783) and Gmelin (1788); but in most cases the names are the same, so that only the authority need be changed.

The names of the species described in these two works — Pennant, 1769, and Forster, 1781 — are given below in parallel columns, the first twelve in the two columns being exact equivalents, though some of Pennant's species are referred to different genera, and the spelling of some of the specific names is more or less altered.

---

[1] These three plates follow the original twelve in Forster's work and are not numbered, and one of them lacks the engraver's signature borne by all the others.

Pennant, 1769.	Forster, 1781.
1. *Sciurus macrourus*, p. 1, pl. i.	1. *Sciurus* (*macrourus*), p. 11, pl. i.
2. *Falco melanoleucos*, p. 2, pl. ii.	2. *Falco melanoleucus*, p. 12, pl. ii.
3. *Otus bakkamoena*, p. 3, pl. iii.	3. *Strix bakkamuna*, p. 13, pl. iii.
4. *Picus miniaceus*, p. 4, pl. iv.	4. *Picus miniatus*, p. 14, pl. iv.
5. *Trogon fasciatus*, p. 4, pl. v.	5. *Trogon fasciatus*, p. 15, pl. v.
6. *Cuculus pyrrhocephalus*, p. 6, pl. vi.	6. *Cuculus pyrrhocephalus*, p. 16, pl. vi.
7. *Columba melanocephala*, p. 6, pl. vii.	7. *Columba melanocephala*, p. 16, pl. vii.
8. *Motacilla sutoria*, p. 7, pl. viii.	8. *Motacilla sutoria*, p. 17, pl. viii.
9. *Gallinula phoenicurus*, p. 10, pl. ix.	9. *Rallus phoenicurus*, p. 19, pl. ix.
10. *Tantalus leucocephalus*, p. 11, pl. x.	10. *Tantalus leucocephalus*, p. 20, pl. x.
11. *Anser melanotos*, p. 12, pl. xi.	11. *Anser melanonotos*, p. 21, pl. xi.
12. *Anhinga melanogaster*, p. 13, pl. xii.	12. *Anhinga melanogaster*, p. 22, pl. xii.
—— ——	13. *Anas poecilorhyncha*, p. 23, pl. xiii, fig. 1.
—— ——	14. *Squalus tigrinus*, p. 24, pl. xiii, fig. 2.
—— ——	15. *Labrus zeylanicus*, p. 24, pl. xiii, fig. 3.
—— ——	16. *Perdix bicalcarata*, p. 25, pl. xiv.
—— ——	17. *Muscicapa flammea*, p. 25, pl. xv.

Of the 12 species described by Pennant, only 3 (Nos. 1, 5, and 11) are currently accredited to him; No. 12 is accredited to Gmelin, and the remaining 8 to Forster, 1781. The proper modern equivalents of Pennant's names, and their current ascriptions, are:

1. *Ratufa macroura* (Pennant); currently attributed to Pennant.
2. *Circus melanoleucos* (Pennant); wrongly attributed to Forster.
3. *Otus bakkamœna* (Pennant) = *Scops bakkamœna* (Pennant). *Cf.* Blandford, Faun. Brit. Ind., Birds, III, 1895, p. 297 (Pennant cited as authority); Sharpe, Hand-List of Birds, I, 1899, p. 286 (Forster cited as authority).
4. *Chrysophlegma miniaceum* (Pennant) = *Chrysophlegma miniatum* (Forster).
5. *Pyrotrogon fasciatus* (Pennant); currently attributed to Pennant.
6. *Phoenicophaus pyrrhocephalus* (Pennant); wrongly attributed to Forster.
7. *Spilotreron melanocephala* (Pennant); wrongly attributed to Forster.
8. *Sutoria sutoria* (Pennant); wrongly attributed to Forster.
9. *Amaurornis phoenicura* (Pennant); wrongly attributed to Forster.
10. *Pseudotantalus leucocephalus* (Pennant); wrongly attributed to Forster.
11. *Sarcidiornis melanonota* (Pennant); currently attributed to Pennant.
12. *Anhinga melanogaster* (Pennant); wrongly attributed to Gmelin.

The three species of birds added in Forster's edition are properly ascribed to him by most writers on Indian ornithology, but in the British Museum 'Catalogue of Birds' (Vol. XXIII, p. 264) one is erroneously attributed to Pennant at 1769.[1] The author was possibly misled by Hume (Stray Feathers,

---

[1] "Perdix bicalcaratus *Penn. Ind. Zool.*, p. 40, pl. vii (1769)"!

VII, 1878, p. 453) who says: "As a matter of fact, Pennant's name *Perdix bicalcaratus* appears to have been first published in the London Folio edition of 1769....," which is, of course, a misstatement. The modern equivalents (as given in Sharpe's 'Hand-List of Birds') of Forster's three species are as follows:

Anas poecilorhynchus = *Polionetta poecilorhyncha* (Forster).
Perdix bicalcaratus = *Galloperdix bicalcarata* ("Penn." = Forster).
Muscicapa flammea = *Pericrocotus flammeus* (Forster).

The plate and description of Pennant's *Otus bakkoemena* (= Forster's *Strix bakkamuna*) are not very satisfactory, but both Oates (Birds of Ceylon, Part I, 1880, pp. 135–138) and Blandford (Faun. Brit. Ind., Birds, III, 1895, pp. 297–300) consider that Pennant's name applies to the little *Scops* Owl of Ceylon and southern India.

A second edition of Pennant's 'Indian Zoology' bears date 1790, although the author's preface is dated "Downing, March 1, 1791." The title-page is as follows:

Indian Zoology, | Second Edition. | [Vignette = "Bird of Paradise, with a view of Dory Harbour, New Guinea"] London. | Printed by Henry Hughs, for Robert Faulder. | MDCCXC.— 4to. pp. i–viii, 1–161 + 1 leaf, containing list of errata, and pll. i–xvi. The plates, reduced in size and reëngraved, are all signed "P. Mazell. Sculp.," except pl. v. unsigned.

This edition is wholly in English, and consists of (1) 'An Essay on India, its Boundaries, Climate, Soil, and Sea' (half-title and pp. 3–12, translated by Dr. John Aiken from the Latin of John Reinhold Forster); (2) 'On the Birds of Paradise, and the Phœnix' (pp. 13–27, translated by Aiken from the Latin of Forster); (3) 'Indian Zoology' (half-title, pp. 31–56, pll. i–xvi), a literal reprint of the English descriptions of the first edition, so far as the species are the same, and new descriptions of the others (not strict translations of Forster's, though possibly based on them); (4) 'The Indian Faunula' (half-title, and pp. 59–161, followed by one leaf, with a list of errata).

The 'Faunula' is a series of nominal lists, made up as follows: the mammals, consisting of English names only and references to Pennant's own 'History of Quadrupeds'; the birds, with English names only, furnished by John Latham from his 'Synopsis of Birds'; the Amphibia, Pisces, Insecta, and Vermes, under Latin names, with references to place of publication. "The more laborious part, relative to the Insects, fell to the share of Mr. [John] Latham; the rest to that of Mr. [Hugh] Davies" (*cf.* preface, p. iii).

From a nomenclatorial standpoint the second edition is unimportant, being practically merely an English reprint of Forster's 'Indische Zoologie,' with a new 'Faunula Indica,' made up by Latham and Davies, by Pennant's solicitation, as explained in the preface. There are several changes in the technical names of the 'Fauna,' as *Picus miniatus* in place of *Picus miniaceus* of the first edition, and bibliographic references to other authors are frequently added; but we have here *Otus bakkamoema*, as in the 1769 edition.

59.57,96(729.5)

Article VI.— THE ANTS OF PORTO RICO AND THE VIRGIN ISLANDS.

By William Morton Wheeler.

Plates XI and XII.

Contributions to our knowledge of the ant-fauna of Trinidad, the Windward Islands and of St. Thomas among the Virgin Islands have been slowly brought together in a number of papers by Mayr, Emery, Urich, and especially by Forel. And Guérin, Roger, Mayr and Forel have recorded a number of species from Jamaica, Cuba, Hayti and San Domingo, but up to the present time practically nothing has been published on the ant-fauna of our recently acquired provinces, Porto Rico, Culebra and Vieques. And while it was possible, of course, to form a general notion of the faunas of these islands from what was known concerning the ants inhabiting the other links of the Antillean chain, it was, nevertheless, desirable to fill this hiatus in our knowledge with actual data. I was therefore very glad to have the opportunity during March, 1906, of visiting Porto Rico and Culebra with a party in charge of the director of the New York Botanical Garden, Professor N. L. Britton. On this expedition Vieques was not visited but Culebra, the "Treasure Island" of Robert Louis Stevenson's well known story, was thoroughly explored. Unfortunately one of the most promising portions of Porto Rico, the rich tropical forests on the slopes of the highest mountain of the island, El Yunque, which rises to an altitude of some 3487 feet, was not included in our itinerary, as the work of the expedition was primarily botanical and as considerable attention had been paid to the plants of this region by collectors previously sent out from the Botanical Garden. While in Culebra, both Professor Britton and myself were much indebted to Captain B. T. Walling, Commandant of the United States Naval Station, and to the gentlemen of his staff for their generous assistance in our work and personal interest in our welfare.

As might be expected, the following annotated list, which includes also the species recorded from St. Thomas, is rather meager, for tropical islands are often much poorer in Formicidæ than continental regions of the same area in more temperate latitudes. Another reason for the poverty of the Porto Rican ant-fauna is to be found in the fact that for many years past this island has been the most densely populated and most intensively cultivated of the West Indies. With the exception of the above mentioned forests of El Yunque, only bits of the virgin forest have been preserved, and these occupy the summits of the higher mountains. Excursions to two of these, Monte Morales and Monte Mandios (altitude about 3000 feet) near Utuado, yielded few species of ants not found at lower elevations in the more cultivated districts. It is probable that even El Yunque is not as rich in species as its luxurious rain-forests might lead one to imagine, for if this were the case it would be difficult to understand how the species could be absent from other parts of so small an island, since ants like other organisms tend to spread more or less beyond their optimum environment.

The ant-fauna of Porto Rico and the Virgin Islands, notwithstanding its poverty, has both a positive and a negative interest and significance, that is, both in what it comprises and in what it falls to comprise. So far as known, the species may be separated into the three following groups, which may also be distinguished in the other West Indian islands:

1. The species common to the American mainland but of long enough residence in the Antilles to have produced in several instances characteristic subspecies or varieties. To this group belongs the great bulk of the ant-fauna of Porto Rico and Culebra.

2. The recently introduced species from the tropics of the Old World. These have been carried by man in ships or merchandise from one island to another, or have been disseminated by winds and currents to many of the islands after introduction into some one of them. Such species are: *Monomorium floricola, destructor, pharaonis* and *salomonis, Pheidole megacephala, Tetramorium guineense* and *simillimum, Tapinoma melanocephalum, Prenolepis longicornis* and perhaps also *Cardiocondyla emeryi* and *venustula.* With the exception of the two species last mentioned, all the members of the genus *Cardiocondyla* are confined to the Old World. *C. emeryi* is common in India and Palestine and *C. venustula,* though now first described from Porto Rico and Culebra, is so closely related to *C. nuda* of Samoa, Tonga, the Sandwich Islands, India and Northern Africa, that it may well have been imported, just as *Monomorium salomonis* has been carried to the Bahamas from Spain or the Sahara.

3. The ancient, presumably autochthonous genera and species or their immediate descendants. Tis is a very small, and owing to the incompleteness of our knowledge of the ant-fauna both of the West Indies and of the tropical mainland, a rather doubtful group. The only Antillean genera not hitherto recorded from the American continent are *Emeryella* and *Epitritus*, the former based on a single worker from Hayti, the latter known to be represented in Europe. The genus *Macromischa,* however, comprising perhaps the most beautiful of all the Formicidæ, though it has two species in Mexico and one in Texas, is very largely Antillean, and none of the West Indian species has as yet been taken on the continent. We may, therefore, infer that this genus at least has arisen on the islands and has within com-

paratively recent times developed its series of peculiar species. These stand out as the native wood-nymphs of the islands in sharp contrast with the mass of Formicid tramps from the Old World and the somewhat commonplace immigrants from the continent.

The following negative peculiarities of the Porto Rican and Culebran ant-fauna may be noticed:

1. The small size of the species in general. Even representatives of the larger *Camponoti* of the *maculatus* and *abdominalis* groups, which occur in some of the other West Indian Islands, are conspicuously absent.
2. The complete absence of some of the well-developed neotropical genera and subgenera, such as *Cryptocerus*, *Dolichoderus*, *Azteca* and *Atta* s. str.
3. The paucity of species belonging to other genera, like *Pseudomyrma*, *Cremastogaster*, *Pheidole* and *Camponotus*, so abundantly developed in other parts of tropical America.

The most abundant ant in Culebra and Porto Rico is, of course, the ubiquitous "fire-ant," or "hormiga brava" (*Solenopsis geminata*), a species so prolific, versatile and aggressive, and so fond of living in cultivated fields and in the neighborhood of human dwellings, that it has probably prevented many introduced species from extending their range or even from gaining a foothold in the islands. Two such species, both of East Indian origin, *Prenolepis longicornis* and *Pheidole megacephala*, have nevertheless managed to establish themselves, the former everywhere in Cuba and Porto Rico, the latter as yet only in certain places. The most careful search failed to reveal the presence of *Ph. megacephala* in Culebra, but in the little island of Culebrita, less than a mile to the eastward, it is in full possession to the exclusion of every other ant. Here I found it everywhere: in the masonry walls of the lighthouse on the highest point of the island, under stones and logs throughout the thickets and in crater nests on the beaches of foraminiferous sand down to high water mark. It is probable that it has been prevented by the *Solenopsis* from gaining a foothold in Culebra, for I can hardly believe that winged females of the *Pheidole* have been unable to cross the narrow channel which separates the two islands. In Porto Rico *Ph. megacephala* is so sporadic in its occurrence as to suggest either that it has been introduced at several widely separated points and has been unable to spread, or that it has been exterminated over a large portion of its range by the fire-ant.

That all three of these species may co-exist in abundance in the same island is shown by Forel's observations in St. Thomas, which he visited in 1878.[1] After enumerating five cosmopolitan species, he says: "Three of these species are so enormously abundant as to give the ant-fauna of the island its present character; these are *P. longicornis*, *S. geminata* and *Ph. megacephala*. The slender, long-legged *P. longicornis* shoots about like an arrow over the rocks and pavements, so that one seems to see only whirring black lines crossing one another on the ground. In all the gardens and thickets abounds the war-like, painfully stinging *S. geminata*, the only one that builds distinct earth-works. In the houses (and in the streets, too), on the other hand, there are swarms of *Ph. megacephala* (*Œcophthora pusilla* Heer), whose habits as a house-ant have been admirably described by Heer.[1] *P. longicornis* also occurs in houses. These three species are

---

[1] Die Ameisen der Antille St. Thomas. Mitth. Münch. Entom. Ver., V, 1, 1881, 16 pp.

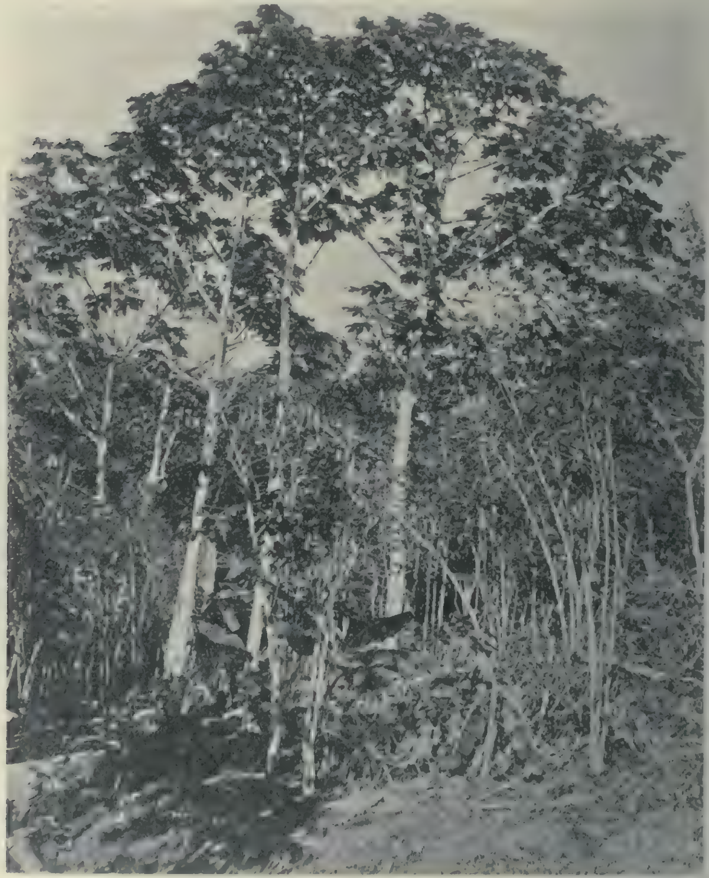


Fig. 1. Group of *Cecropia peltata* L. on mountains near Utuado, P. R. (Photograph by Dr. M. A. Howe.)

---

[1] Die Hausameise Madeiras; Zürich, Höhr, 1852.

found everywhere in the island." Forel mentions *P. longicornis* as nesting on board the steamer "Silesia," a fact suggestive of the way in which it has been transported to all parts of the world.

According to Heer's and Forel's observations, *Ph. megacephala* is especially fond of nesting in the fissures of rocks and pavements and in the crannies of masonry walls. This may account for its absence in Culebra, where there are no pavements and only wooden dwellings, affording no retreat in which it could breed unmolested by the savage fire-ant. *P. longicornis*, which is popularly known in tropical Florida as the "crazy

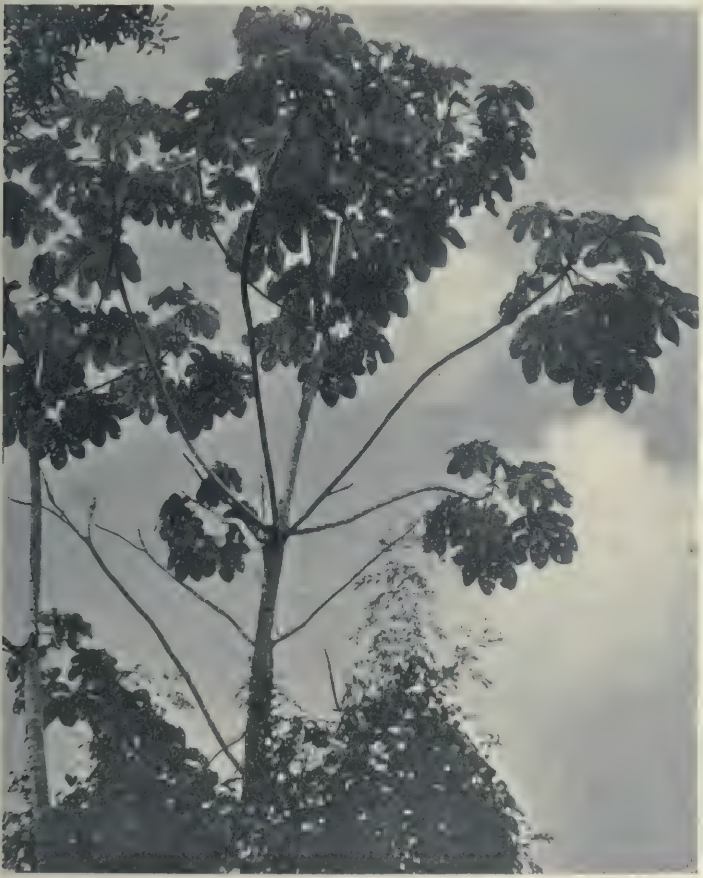


Fig. 2. *Cecropia peltata* showing foliage perforated by insects. Mountains near Utuado, P. R. (Photograph by Dr. M. A. Howe.)

ant," and in Cuba as the "hormiga loca," is probably able to hold its own on account of its wonderfully agile and disconcerting gait, and the dispatch with which it can carry away its brood when its formicaries are disturbed or attacked.

The meagerness of the native ant-fauna of Porto Rico and Culebra, may also, I believe, be attributed in great measure to the aggressive habits of *S. geminata.* This ant prefers to nest in open, sunny places and especially in sandy or loamy soil. It is much less frequent in shady woods or damp spots. *Pheidole jelskii* var. *antillensis* does, indeed, manage to nest in the same stations as the *Solenopsis,* but the workers can run rapidly like those of *Prenolepis,* and the soldiers are probably protected by their very nauseating odor which resembles that of the legionary ants of the genus *Eciton.* All the other ants are either hypogæic in their habits, nest under stones in the woods and damp places, where the *Solenopsis* does not care to live, or inhabit the hollow twigs of trees and bushes where they are safe from the attacks of this and other species.

I was not a little surprised to find a tree that might be supposed to surpass all others in affording shelter for ants in its hollow stems, quite destitute of these insects. This is the *Cecropia peltata* Linn. which is common on the rocky slopes of the mountains in many parts of Porto Rico (Figs. 1 and 2). In the structure of its stems and foliage it closely resembles the Brazilian *C. adenopus* (= *peltata* Vellozo *nec* Linn.) which, according to Fritz Müller, Schimper and von Ihering, is almost always inhabited by colonies of *Azteca muelleri.* The internodal pits which enable the *Azteca* to perforate the stems with greater facility and enter their spacious cavities, and the Müllerian bodies on which the ants feed, are also clearly present in the Porto Rican *Cecropia.* In this tree the bodies are coral red, but are embedded, as in the Brazilian species, among the hairs of the cushion (trichilium) at the base of the leaf-petiole. On first seeing these trees I naturally expected to find them teeming with ants, but with the exception of a single colony of a small and timid species (*Iridomyrmex melleus*), inhabiting a dead and broken branch, I was unable to find any ants either in the cavities or on the branches and foliage, though I carefully scrutinized every *Cecropia* I could reach in several different localities. The *Iridomyrmex* certainly prefers the small twigs of other trees and bushes and its occurrence in the *Cecropia* was exceptional. I would also call attention to the fact that the trees were in excellent health, although their foliage, in nearly all cases, had been much eaten by insects (Fig. 2). It is certain, therefore, that *C. peltata,* though possessing essentially the same structure as the Brazilian *adenopus,* is not myrmecophilous, at least in Porto Rico. This seems to be true also of some other species of *Cecropia* in the mountains of South America, and lends support to Rettig's view[1] that the ants have adapted themselves to trees already possessing certain morphological peculiarities which have therefore been developed without any reference to myrmecophily.

The island of Culebra is composed of volcanic rock and is clearly xerophytic as attested by several prominent species of Cactaceæ in its flora. Its highest point which is only a little over 600 feet above sea-level, is too low to intercept the rain-laden trade-winds from the Atlantic, and the small amount of water which falls on its hilly surfaces flows off rapidly into the sea. The high mountain range which traverses Porto Rico from east to west divides the island into a northern humid and a southern arid region. The flora and fauna of the latter region bear an unmistakable resemblance to those of Culebra and of the xerophytic Bahamas. These differences in the distribution of moisture, however, do not seem to express themselves very clearly in the distribution of the Formicidæ. Of the sixty-five species, subspecies and varieties of these insects recorded in the following pages, twelve have been found only in St. Thomas, four only on Culebra, and twenty-one only on Porto Rico; eleven are common to Culebra and Porto Rico, five to St. Thomas and Porto Rico, and twelve occur on all three of the islands.

Subfamily PONERINÆ.

1. **Ectatomma quadridens** (*Fabr.*).

Formica quadridens FABRICIUS, Entom. System., II, 1793, p. 362, no. 51. ☿.
Ponera quadridens ILLIGER, Mag. f. Insektk., VI, 1807, p. 194.
Ectatomma brunnea F. SMITH, Catalog. Hymen. Brit. Mus., VI, 1858, p. 103, no. 2, ☿ ♀.
Ponera (Ectatomma) quadridens ROGER, Berl. Entom. Zeitschr., IV, 1860, p. 307, no. 37, ♀.
Ectatomma quadridens MAYR, Verh. zool. bot. Ges. Wien, XII, 1862, p. 732, no. 2.

Mayr cites a specimen of this ant in the Vienna Museum as doubtfully coming from St. Thomas. Forel found no species of the genus *Ectatomma* in that island, and I have seen no trace of them in Culebra or Porto Rico.

2. **Platythyrea punctata** (*F. Smith*).

Pachycondyla punctata F. SMITH, Catalog. Hymen. Brit. Mus., VI, 1858, p. 108, no. 9, ☿ ♂.
Platythyrea punctata ROGER, Berl. Entom. Zeitschr., VII, 1863, p. 173.
Platythyrea inconspicua MAYR, Verh. zool. bot. Ges. Wien, XX, 1870, p. 961, ♀.
Platythyrea pruinosa MAYR, *ibid.*, p. 962, ☿.
Platythyrea punctata FOREL, Rev. Suisse Zool., IX, 3, 1901, p. 335.

---

[1] Ameisenpflanzen-Pflanzenameisen. Ein Beitrag zur Kenntnis der von Ameisen bewohnten Pflanzen und der Beziehungen zwischen beiden. Botan. Centralbl., XVII, Beih. 1904, pp. 89–122.

Porto Rico: Between Arecibo and Utuado.

A couple of workers found running on the ground in a shady cafetal. The types of this species, which is widely distributed in tropical America, were from San Domingo. Forel has recorded it from Barbados, Jamaica, Martinique, Guadeloupe, St. Vincent and Grenada. It is known also to occur in Colombia, Mexico, Venezuela and the Bahamas.

3. **Euponera (Pseudoponera) stigma** (*Fabr.*).

Formica stigma Fabricius, System. Piez., 1804, p. 400, no. 18, ♀.
Ponera quadridentata F. Smith, Journ. Proc. Linn. Soc., Zool., III, 1858, p. 143, no. 4, ♀.
Ponera americana Mayr, Verh. zool. bot. Ges. Wien, XII, 1862, p. 722, no. 3, ☿.
Ponera stigma Emery, Ann. Mus. Civ. Genova, XXV, 1887, p. 434, no. 136, ☿.
Pachycondyla (*Pseudoponera*) *stigma* Emery, Ann. Soc. Entom. Belg., XLV, 1901, p. 46.
Euponera (*Pseudoponera*) *stigma* Forel, Ann. Soc. Entom. Belg., XLV, 1901, p. 398; Rev. Suisse Zool., IX, 3, 1901, p. 339.

Culebra; Porto Rico: Utuado.

Numerous workers from small colonies nesting under stones or logs. One colony in Culebra was found nesting in a rotten Cactus stump.

4. **Neoponera villosa** (*Fabr.*).

Formica villosa Fabricius, System. Piez., 1804, p. 409, no. 55, ☿.
Ponera villosa Illiger, Mag. f. Insektk., VI, 1807, p. 194, ☿.
Ponera bicolor Guérin, Iconogr. Régn. Anim., VII, Insect., 1845, p. 242, no. 2, ☿.
Ponera pedunculata F. Smith, Catalog. Hymen. Brit. Mus., VI, 1858, p. 96, no. 46, tab. 6, fig. 25, ☿.
Pachycondyla villosa Mayr, Verh. zool. bot. Ges. Wien, XII, 1862, p. 721, no. 1.
Neoponera villosa Emery, Ann. Soc. Ent. Belg., XLV, 1901, p. 47.

Porto Rico (Am. Mus. Nat. Hist.).

The label on this specimen may not be authentic, and should perhaps read "Costa Rica," although it is, of course, possible that this conspicuous species may have been imported into Porto Rico with Central or South American orchids. I could find no traces of it in the localities where I collected, nor has it been recorded, to my knowledge, from any of the other islands of the West Indies.

5. **Ponera opaciceps** *Mayr.*

Mayr, Verh. zool. bot. Ges. Wien, XXXVII, 1887, p. 536, ☿ ♀.

Culebra; Porto Rico: Utuado; Monte Morales; Monte Mandios; Coamo Springs.

Not uncommon under stones or under the bark of decaying logs in damp places. This species is widely distributed, occurring as far north as the Bahamas and Texas.

6. **Ponera ergatandria** *Forel.*

Forel, Trans. Entom. Soc. London, 1893, p. 365, ☿ ♀ ♂.

Porto Rico: Utuado.

Two workers taken under prostrate plaintain stems. The male of this species, which, like the preceding occurs in the Bahamas and in Texas, is wingless and ergatoid, as Forel has shown.

7. **Anochetus mayri** *Emery.*

Emery, Ann. Mus. Civ. Genova, XXI, 1884, p. 378, no. 1, ☿; Ann. Soc. Entom. France, (6) X, 1890, p. 65, ☿ ♀.

St. Thomas (Emery); Porto Rico: Utuado, Vega Baja, Monte Morales, Monte Mandios, Coamo Springs, Morro at San Juan, Adjuntas, Arecibo.

Common under dead leaves and stones in the shade of the cafetals and platanals. The colonies are small, comprising only about a dozen individuals. Usually one finds isolated workers or females moving about under cover of the dead leaves in search of prey. The females seem to be apterous, although the thorax is large and of the usual structure. Specimens with distinct wing-stumps are rare. The larvæ are covered with pointed tubercles and resemble those of *Odontomachus*; the cocoons are rather broad, lemon yellow, with a black meconial spot at the anal pole.

8. **Anochetus (Stenomyrmex) emarginatus testaceus** *Forel.*

Forel, Trans. Ent. Soc. London, 1893, p. 356, ☿ ♂; *ibid.*, 1897, p. 298, ☿.

Culebra.

Several colonies nesting under stones in the shade of trees along the dry arroyos on the higher part of the island (Monte Resaca). The number of individuals in a colony varies from about thirty to one hundred. The cocoons are long and slender like those of *Leptogenys*.

9. **Odontomachus hæmatodes** (*L.*).

Formica hæmatoda Linné, System. Natur., Ed. 10, I, 1758, p. 582, no. 16, ☿.
Formica maxillosa Goze, De Geer, Abh. Gesch. Insect., III, 1780, p. 390, no. 2, ☿. Taf. XXXI, figs. 3–5.

Formica unispinosa Fabricius, Entom. System., II, 1793, no. 359, ☿.
Myrmecia unispinosa Fabricius, System. Piez., 1804, p. 423, no. 1, ☿.
Odontomachus hæmatodes Latreille, Hist. Nat. Crust. et Insect., XIII, 1805, p. 257, ☿.

Porto Rico: Arecibo, Utuado, Monte Morales, Monte Mandios, Adjuntas, Vega Baja, Aibonito, Coamo Springs.

Common, nesting under stones or logs or in untidy mound nests about the roots of trees, but only in shady places and rather rich soil.

10. **Odontomachus hæmatodes** *L.* var. **ruginodis** *Wheeler.*

Wheeler, Bull. Am. Mus. Nat. Hist., XXI, 1905, p. 82, ☿ ♀.

Porto Rico: Utuado, Adjuntas, Coamo Springs.

This variety, which is less common than the typical form of the species, was found only in open, sunny places in the sandy soil of river bottoms. It is smaller than the typical *hæmatodes*, has a paler head, and the petiole is less acuminate above, with a shorter spine.

Subfamily MYRMICINÆ.

11. **Pseudomyrma flavidula** *F. Smith.*

F. Smith, Catalog. Hymen. Brit. Mus., VI, 1858, p. 157, no. 15, ☿; Wheeler, Bull. Am. Mus. Nat. Hist., XXI, 1905, p. 83, ☿ ♀ ♂.

Porto Rico: Tallaboa.

A single worker of this species, running on the twigs of a bush, was the only specimen of the genus seen in Porto Rico and Culebra.

12. **Monomorium destructor** (*Jerdon*).

Atta destructor Jerdon, Madras Journ. Lit. and Sci., XVII, 1851, p. 105. ☿.
Myrmica vastator F. Smith, Journ. Proc. Linn. Soc., Zool., II, 1857, p. 71, no. 3. ☿.
Myrmica ominosa Gerstaecker, Monatsb. Akad. Wiss. Berl., 1858, p. 263, no. 18. ☿.
Myrmica atomaria Gerstaecker, *ibid.*, p. 263, no. 19, ☿.
Myrmica (Monomorium) vastator F. Smith, Catalog. Hymen. Brit. Mus., VI, 1858, p. 123, no. 37, ☿.
Myrmica (Monomorium) basalis F. Smith, *ibid.*, p. 125, no. 43, ☿.
Monomorium basale Mayr, Reise d. Novara, Zool., II, 1. Formicidæ, 1865, p. 92, no. 3. ☿.
Monomorium destructor Emery, Dalla Torre, Catalog. Hymen., VII, 1893, p. 66.

Porto Rico: Tallaboa.

A single colony of this now widely distributed ant was found nesting at the base of a tree (*Acacia farnesiana*) on the road between Ponce and Tallaboa. The workers were moving in files up and down the trunk. It is said that this species in its native country (India) is, like the rat, instrumental in disseminating the bubonic plague.

13. **Monomorium pharaonis** (*L.*).

Formica pharaonis LINNÉ, System. Natur., Ed. 10*a*, I, 1758, p. 580, no. 7, ☿.
Formica antiguensis FABRICIUS, Entom. System., II, 1793, p. 357, no. 30.
Myrmica domestica SHUCKARD, Magaz. Nat. Hist., n. s., II, 1838, p. 626, ☿ ♀.
Myrmica unifasciata BOSTOCK, Trans. Entom. Soc. London, II, 3, 1839, Proc. LI–LII.
Atta minuta JERDON, Madras Journ. Litt. and Sci., XVII, 1851, p. 105.
Myrmica (Monomorium) fragilis F. SMITH, Catalog. Hymen. Brit. Mus., VI, 1858, p. 124, no. 42, ☿.
Myrmica (Monomorium) contigua F. SMITH, *ibid.*, 1858, p. 125, no. 44, ♀.
Monomorium pharaonis MAYR, Verh. zool. bot. Ges. Wien, XII, 1862, p. 752, no. 1.

Culebra; Porto Rico: San Juan, Arecibo.

This ant, which has now been introduced into nearly all parts of the world, is common in the houses and hotels. In Culebra it was also found nesting out of doors in the ground near the old government house.

14. **Monomorium carbonarium ebeninum** *Forel.*

Monomorium carbonarium FOREL, Mitth. Münch. Entom. Ver., V, 1881, p. 8, no. 7, ☿.
Monomorium minutum MAYR race *ebeninum* FOREL, Grandidier's Hist. Nat. et Pol de Madagascar, XX, 1891, pt. 2, p. 165.
Monomorium carbonarium F. SMITH race *ebeninum* FOREL. Biol. Centr. Amer., Hymen., III, 1899–1900, p. 78.

St. Thomas (Forel); Culebra; Porto Rico: Santurce, Utuado, Coamo Springs, Aibonito, Adjuntas, Arecibo, Vega Baja.

Common under stones, in Tillandsias and under bark. A number of females taken from a single nest at Arecibo are wingless and subergatoid like those I have described from the Bahamas.

15. **Monomorium floricola** (*Jerdon*).

Atta floricola JERDON, Madras Journ. Lit. and Sci., XVII, 1851, p. 107, ☿.
Monomorium speculare MAYR, Sitzb. Akad. Wiss. Wien, LIII, 1866, p. 509, ☿.
Monomorium pœcilum ROGER, Berl. Entom. Zeitschr., 1863, p. 199, ☿ ♀.
Monomorium floricola EMERY, Dalla Torre, Catalog. Hymen., VII, 1893, p. 66.

Culebra; Porto Rico: Vega Baja, Coamo Springs, Tallaboa.

Common in Tillandsias, under the bark-scales of trees and in hollow twigs. All the females were apterous like those of this and the preceding species seen in the Bahamas (Wheeler, Bull. Am. Mus. Nat. Hist. XXI, pp. 87, 88, figg. D and E).

16. **Monomorium subcœcum** *Emery.*

Emery, Bull. Soc. Entom. Ital., XXVI, 1894, p. 14 (of reprint), ☿ ♀.

St. Thomas (Emery).

This pale yellow species, according to Emery's description, is very aberrant, having the eyes reduced to single facets. It is allied to the East Indian *M. fossulatum* Emery.

17. **Cardiocondyla emeryi** *Forel.*

Plate XI, Fig. 6.

Forel, Mittheil. Münch. Entom. Ver., V, I, 1881, p. 5, no. 3, ☿.

St. Thomas (Forel); Vieques (Busck); Culebra; Porto Rico: San Juan, Santurce, Utuado, Adjuntas, Coamo Springs.

This species, originally described from St. Thomas, has since been found to be widely distributed, not only in the West Indies, but also in India, Palestine and Madagascar. I have recorded it from the Bahamas and Bermuda, and have a specimen from Cayamas, Cuba (E. A. Schwarz). The individual collected by Busck in Vieques is a winged male. The colonies of this ant are small and in sandy places, especially in river or creek bottoms and on sea beaches. The female is still unknown though the worker was described more than a quarter of a century ago.

18. **Cardiocondyla venustula** sp. nov.

Plate XI, Fig. 5.

Worker. 2–2–25 mm.

Head longer than broad, as broad in front as behind, with faintly convex, subparallel sides and nearly straight posterior border. Mandibles rather narrow, 6-toothed. Clypeus convex in the middle behind, with straight anterior border. Frontal area small, triangular, elongated. Antennal scapes not reaching the posterior corners of the head by a distance somewhat greater than their largest transverse diameter. Second and seventh funicular joints as long as broad; joints 3–6 broader than long; terminal joint longer and larger than the two preceding unequal joints together. Thorax slender, with rounded, sloping humeri and pronounced mesoëpinotal constriction. Epinotum with two rather blunt teeth, which are as long as broad at their bases; basal surface slightly convex, nearly twice as long as the concave declivity. Petiole slender, node from above spherical, as long as broad and as long as the slender peduncle, into which it narrows rather abruptly. Postpetiole only 1½ times as long as the petiole and barely half as broad as the first gastric segment, but little broader than long, transversely elliptical; in profile distinctly lower than the petiolar node. Gaster elongate elliptical, somewhat flattened above. Legs slender.

Mandibles obscurely and sparsely punctate. Clypeus and frontal area somewhat shining, the former indistinctly, longitudinally rugulose. Head opaque, finely and regularly reticulate-rugulose. Thorax and post-petiole opaque, finely and densely punctate on the sides and below, above somewhat shining, with smaller punctures; petiole still smoother and more shining throughout, with distinct and very small punctures above. Gaster glabrous, with minute scattered punctures. Legs somewhat shining.

Appressed pubescence covering the body and appendages grayish, somewhat longer and sparser on the gaster. Hairs very few, confined to the anterior border of the clypeus.

Dark reddish brown; head and gaster nearly black; mandibles, antennal scapes and legs more yellowish; funiculi and the greater portion of the femora and tibiæ, especially of the posterior legs, and the nodes of petiole and postpetiole, infuscated.

Female. Length 2.75–3 mm.

Resembling the worker. Thorax narrower than the head, more than twice as long as broad, somewhat flattened above. Epinotal teeth stronger than those of the worker but of the same shape. Petiole and postpetiole of the same shape and proportions.

Head, thorax and postpetiole opaque above; petiole slightly more shining; all of these parts uniformly reticulate-rugose; the mesonotum behind with more longitudinal rugæ; epinotal declivity smooth and shining.

Pubescence as in the worker. Wings minutely hairy, with a long marginal fringe on the posterior pair.

Head, thorax and nodes of petiole uniformly dark brown; gaster black, except the bases of segments 2–4, which are yellowish. Mandibles, legs and antennæ of the same color as in the worker. Wings white, with colorless veins and stigma.

Culebra; Porto Rico: Coamo Springs.

This species is very closely related to *C. nuda* Mayr of India, Tonga and Samoa, and more remotely to *C. parvinoda* Forel of India. The worker may be distinguished from that of *nuda* by the shape and proportions of the petiole and postpetiole. In *nuda* the petiolar node is less abruptly marked off from the peduncle and is distinctly longer than broad, while the postpetiole is fully twice as broad as the petiole and its sides are roundly angular when seen from above. The epinotal spines are more robust and the mesoëpinotal furrow is not so deep. From *parvinoda*, *venustula* differs in its much darker color, and in having the thorax more slender, less flattened above, with more rounded humeri and much smaller epinotal teeth.

C. venustula is not uncommon in sandy and gravelly places, especially on the sea-beaches, where it lives in small colonies, comprising a single deälated queen and a few dozen workers, in shallow nests like those of some species of *Leptothorax*. It was found in Culebra in the same stations as *C. emeryi*. At Coamo Springs a few winged females were captured March 23, while they were issuing from a nest in a gravelly creek bottom.

19. **Solenopsis geminata** (*Fabr.*).

For the elaborate synonymy of this species see MAYR, Novara Expedit. Zool., II, 1. Formicidæ, p. 108, and DALLA TORRE, Catalog. Hymenopt., VII, 1893, p. 76.

St. Thomas (Forel); Culebra; Porto Rico: Arecibo, Adjuntas, San Juan, Santurce, Vega Baja, Utuado, Monte Morales, Monte Mandios, Coamo Springs, Ponce, Tallaboa, Mayaguez.

This, the commonest of all the ants on the islands visited, was found everywhere, except in the little island of Culebrita. All the specimens are of the typical dark form of the species, except those from Mayaguez, which are paler and redder. This ant not only stores up seeds in its nests and is highly carnivorous, but it also attends aphids and coccids. In Culebra I found it visiting aphids on the leaves of a superb milk-weed (*Callotropis procera*), and in several localities in this island and in Porto Rico it was seen attending coccids on the roots of grasses and on the bark of trees. Winged females and males were found in the nests March 4 to 24.

20. **Solenopsis globularia** (*F. Smith*).

Myrmica (Monomorium) globularia F. SMITH, Catalog. Hymen. Brit. Mus., VI, 1858, p. 131, no. 68, ☿ ♀ ♂.
Solenopsis steinheili FOREL, Mitth. Münch. Entom. Ver., I, 1881, p. 11, no. 11, ☿.
Solenopsis globularia FOREL, Bull. Soc. Vaud. Sc. Nat. (2), XX, 1884, p. 376.

St. Thomas (Forel).

The typical form of this species from Brazil is described by Smith as "pale rufo-testaceous, very smooth and shining, with a rufo-fuscous band on the abdomen, the basal and apical margins pale." This description seems to agree very well with the specimens described by Forel from St. Thomas, but the numerous specimens which I collected in Culebra and Porto Rico are much darker and may be designated as a distinct variety:

21. **Solenopsis globularia** var. **borinquenensis** var. nov.

PLATE XI, FIG. 7.

Culebra; Porto Rico: Morro at San Juan.

The worker of this form has the posterior portion of the head, the pronotum and the whole or nearly the whole of the first gastric segment, dark brown, in some specimens almost black. The postpetiole is transversely elliptical, distinctly broader than long. This form nests in the white sand of the sea-beaches just above high-water mark.

The form which I cited in a former paper as *S. globularia* from Andros I., Bahamas, is really a distinct subspecies, which may be called *lucayensis* subsp. nov. It is pale yellow throughout, with only a faint fuscous trace of the gastric band and the petiole and postpetiole are much narrower than in the typical form or in the var. *borinquenensis*, the postpetiole being nearly as long as broad and much narrower than the first gastric segment. (Pl. XI, Fig. 8.)

22. **Solenopsis corticalis** *Forel.*

FOREL, Mitth. Münch. Entom. Ver., V, 1, 1881, p. 13, no. 12, ☿ ♀.

St. Thomas (Forel); Porto Rico: Utuado.

A single colony, comprising a deälated female and a number of workers, was found in the stem of a bamboo.

23. **Solenopsis picea** *Emery.*

EMERY, Bull. Soc. Entom. Ital., XXVIII, 1896, p. 57 (of reprint), ☿ ♀.

Porto Rico: Utuado.

A number of workers, taken from a single colony nesting under the bark of a rotting log, agree very closely with types of this species from Costa Rica.

24. **Solenopsis azteca** *Forel* var. **pallida** var. nov.

Porto Rico: Coamo Springs.

A number of workers, taken from a small nest under a boulder in a dry stream bed, differ from some of Forel's types from St. Vincent in their much paler coloration. The body and appendages are yellow, the head has a reddish brown cloud on the vertex and the first gastric segment a dark brown transverse band. *S. azteca* seems to be closely related to *S. sulphurea* Roger of Venezuela, the worker of which, as Emery has recently shown, also lacks the teeth on the border of the clypeus but has well developed clypeal ridges. Judging from Emery's figure, Roger's species has smaller eyes and longer antennal scapes than *azteca*.

25. **Cremastogaster victima** *F. Smith* var. **steinheili** *Forel.*

Cremastogaster steinheili FOREL, Mitth. Münch. Entom. Ver., V, 1, 1881, p. 15, no. 13, ☿.

Cremastogaster victima var. *steinheili* EMERY, Zool. Jahrb. Abth. f. Syst., VIII, 1894, p. 288, *nota*.

St. Thomas (Forel); Culebra; Porto Rico: Coamo Springs, Vega Baja, Aibonito.

Common; nesting in Tillandsias, under bark or in the hollow twigs of various trees. This variety, which seems to be widely distributed through the West Indies, is closely related to the var. *missouriensis* Pergande which ranges as far north as Missouri. In one locality in Culebra colonies of *steinheili* were found to have constructed "sheds" or "tents" of fine vegetable débris over coccids, both on the upper and lower surfaces of the large shining leaves of a tree (*Cordia macrophylla*). These sheds were small, flattened or conical structures each covering only one or a few coccids.

26. **Pheidole fallax jelskii** *Mayr* var. **antillensis** *Forel.*

PLATE XII, FIG. 24.

Pheidole fallax FOREL, Mitth. Münch. Ent. Ver., V, 1, 1881, no. 9, 4 ☿.

Ph. jelskii var. *antillensis* FOREL, Ann. Soc. Entom. Belg., XLV, 1901, p. 356.

St. Thomas (Forel); Culebra; Porto Rico: Utuado, Monte Morales, Monte Mandios, Morro at San Juan, Santurce, Coamo Springs, Vega Baja.

The specimens collected from more than a dozen nests agree very closely with those taken on the Bahamas and undoubtedly belong to the variety *antillensis*. To Forel's description of the nests of this form I have only to add that the crater opening is usually slit-shaped or irregular and not round, at least in Culebra and Porto Rico. In the latter island I have seen craters nearly a foot in diameter, sometimes with several openings close together. Males and winged females were taken from two colonies in Culebra as early as March 4 and 6. In this island *antillensis* nests indifferently on the lava slopes, in the sand of the sea-beach or in the compact soil of the roads.

Ph. fallax becomes more puzzling as more material is brought to light. Forel has finally decided to separate the form which Mayr described as var. *jelskii* from *fallax* and to regard it as a distinct species, but an examination of specimens from a number of localities, including cotypes of Forel's and Emery's varieties and subspecies, leaves me in doubt as to the specific value of *jelskii.* The soldiers of the described forms may be distinguished by means of the following table:

1. Occipital incisure of head very deep, narrow at the bottom; antennal scapes robust, reaching only a short distance behind the eyes (*fallax* Mayr = *colombica* Forel var. *rubens* Forel, Pl. XII, Fig. 25) . . . . 2.
   Occipital incisure much more shallow; antennal scapes more slender, reaching to between ⅓ and ½ the distance from the eyes to the posterior corners of the head (*jelskii* Mayr) . . . . 5.
2. Head and thorax both deep ferruginous red (Cuba; Colombia; Jamaica) *fallax* Mayr (typical)
   Head paler than the gaster and posterior portion of the thorax, which are black 3.
3. Head yellowish; its posterior corners somewhat smooth and shining (Colombia) subsp. *colombica* Forel.
   Head deep ferruginous red; its posterior corners sculptured and opaque . 4.
4. Anterior third of first gastric segment opaque, densely punctate (Brazil) subsp. *emiliæ* Forel
   Less than one-third of the first gastric segment punctate; sculpture of head coarser and more reticulate; antennal scapes shorter (Brazil, Chaco) var. *retifera* Emery.
5. First gastric segment shining . . . . 6.
   First gastric segment in great part subopaque and finely punctate . . 7.
6. Sculpture of head feeble (Cayenne) . . subsp. *jelskii* Mayr (typical).
   Sculpture of head stronger and denser; color more vivid; head somewhat smaller; antennal scapes somewhat longer (Trinidad, St. Vincent, Bahamas, Porto Rico) . . . . var. *antillensis* Forel.
7. Thorax, pedicel and gaster dark brown, head lighter, reddish brown; sculpture like that of the typical *jelskii*, with the posterior corners of the head smooth and shining (Venezuela; Brazil) . . . . . var. *fallacior* Forel.
   Ferruginous red throughout, sculpture of head and thorax very strong; posterior corners of the former not shining; first gastric segment largely opaque and punctate (Brazil; Tucuman) . . . . . . var. *arenicola* Emery.

27. **Pheidole megacephala** (*Fabr.*).

For the extensive synonymy of this species see DALLA TORRE, Catalog. Hymen., VII, 1893, p. 92.

St. Thomas (Forel); Culebrita; Porto Rico: Aibonito, Arecibo, Mayaguez.

28. **Pheidole subarmata** *Mayr.* var. **borinquenensis** var. nov.

PLATE XII, FIGS. 19–21.

Porto Rico: Morro at San Juan, Santurce, Utuado.

This variety is closely related to var. *elongatula* Forel of St. Vincent.

The head of the soldier is quite as much elongated, but the sides are straighter. The body is dark chestnut brown, with the discs of the mandibles, a band across the head in front of the eyes, and the antennæ, deep red. The legs, including the coxæ, are yellow, the antennal clubs fuscous. In some specimens the posterior corners of the head, the pedicel and base of gaster are also somewhat reddish. The coloration of the worker is very much like that of the soldier. Types of var. *elongatula* received from Professor Forel and specimens of the typical *subarmata* from South and Central America are much paler and intermediate in color between the Porto Rican variety and the yellow var. *nassavensis* which I have described from the Bahamas.

The formicaries of the var. *borinquenensis* are small craters thrown up in sandy, sunny places like roads and creek bottoms. There are only a few soldiers and workers in a colony.

29. **Pheidole flavens sculptior** *Forel.*

Forel, Trans. Entom. Soc. London, 1893, p. 414, ♃ ☿ ♀.

Porto Rico: Coamo Springs.

A single soldier agrees very well with Forel's description of this subspecies, first taken in St. Vincent, and characterized by having the entire head of the soldier and female sculptured, even to the posterior corners, with only the region immediately surrounding the occipital foramen smooth and shining.

30. **Pheidole flavens exigua** *Mayr.*

Pheidole exigua Mayr, Horæ Soc. Entom. Ross., XVIII, 1884, p. 36 ♃.
Pheidole flavens subsp. *exigua* Emery, Bull. Soc. Ent. Ital., XXVIII, 1896, p. 50 (of reprint).

Soldier. Length 2.25–2.5 mm.

Head, excluding the mandibles, a little longer than broad, a little broader in front than behind, with rounded posterior corners, deep occipital excision and pronounced occipital impression, convex in the middle, without a frontal furrow but with elongated, flattened impressions, or scrobes for the antennal scapes. Eyes at the anterior third of the head. Mandibles moderately convex, with two larger apical and two smaller basal teeth. Anterior border of gula with a pair of prominent teeth. Clypeus short, moderately flattened, its anterior border with three subequal sinuate excisions, so that it appears to be bluntly bidentate. Frontal area triangular, with a median carinula. Frontal carinæ as long as the antennal scapes, the latter reaching half the distance between the eyes and the occipital excision. Antennal club as long as the remainder of the funiculus; joints 2–9 small, broader than long. Thorax small and narrow, through the prominent humeri barely half as long as the head; pro- and mesonotum convex, the latter angular in profile; mesoëpinotal constriction deep and broad. Epinotum in profile with subequal base and declivity, the former convex, the latter concave and sloping, bordered on each side with a prominent ridge, which is continued into the acute, erect spines. The latter are a little longer than broad at their bases and further apart than long. Median portion of epinotum concave. Petiole from above suboblong, more than twice as long as broad, as broad in front as behind, with sides slightly concave in the middle; node compressed anteroposteriorly, with long concave anterior and abrupt posterior slopes; its upper border is entire and somewhat convex from behind, and rather sharp and acute in profile. Postpetiole about 1½ times as broad as the petiole, broader than long, broadest near the anterior border, with prominent but rather blunt anterior angles. Gaster somewhat smaller than the head. Legs rather slender.

Shining; anterior ¾ of head, thorax, petiole, and sides of post-petiole subopaque. Mandibles sparsely punctate, with coarsely rugose bases. Clypeus smooth, except the antero-lateral portions, which are sparsely and longitudinally rugose. Anterior ¾ of head, with the exception of the scrobe-like depressions, longitudinally rugose, with punctate interrugal spaces. The rugæ between the frontal carinæ are subparallel. On the sides of the head they stop abruptly at the scrobe-like depressions which are indistinctly punctate and shining. Pro- and mesonotum and epinotal declivity transversely rugose; remainder of thorax, petiole and sides of postpetiole densely punctate.

Hairs yellowish; long, suberect and abundant on the body; shorter and more reclinate on the legs and antennal scapes.

Head, thorax and pedicel pale ferruginous; gaster, antennæ and legs yellow. Borders of mandibles and anterior border of clypeus dark brown or black.

Worker. Length 1.3 mm.

Head, excluding the mandibles, a little longer than broad, with slightly convex sides, and slightly concave posterior margin. Eyes in front of the middle of the head. Mandibles with two acute apical and several indistinct basal teeth. Anterior border of clypeus straight and transverse in the middle, its surface rather convex. Antennal scapes reaching a little beyond the posterior corners of the head. Thorax similar to that of the soldier, but with more rounded and sloping humeri, and with the pro- and mesonotum distinctly flattened in profile. Epinotal spines small and very acute. Petiole smilar to that of the soldier, but with the node rounded and not compressed anteroposteriorly. Postpetiole but little broader than the petiole, nearly as long as broad, sub-spherical. Gaster about as large as the head.

Mandibles shining, striatopunctate; head, thorax and petiole opaque, densely and uniformly punctate; head in front of the eyes with a few longitudinal rugæ. Gaster glabrous.

Pilosity and color like those of the soldier, but the hairs on the body are sparser. The borders of the mandibles and clypeus are brown.

Female (deälated). Length 2.75–3 mm.

Head like that of the soldier, but proportionally broader and with less excised posterior border. Antennal scapes reaching nearly to the posterior corners. Thorax through the wing-insertions as broad as the head through the eyes, flattened above and much narrowed in the epinotal region. Epinotal spines stout, acute, longer than broad at their bases, directed upward and backward and at their bases further apart than long. Petiole similar to that of the soldier but with the upper border of the node deeply excised in the middle. Postpetiole twice as broad as the petiole, with its anterior border straight and produced on each side as a blunt but prominent angle, posterior portion much narrower. Gaster elongate elliptical, flattened above.

Smooth and shining, especially the mesonotum and gaster. Head subopaque, with sculpture similar to that of the soldier, except that the rugæ extend over the posterior corners and occipital excision. Pleuræ opaque, punctate-rugulose; epinotum with prominent transverse rugæ. Petiole and postpetiole opaque, finely punctate-rugulose. Mesonotum and gaster with small, scattered, piligerous punctures.

Deep chestnut brown, anterior portion of head, pleuræ and peduncle of petiole paler. Mandibles, antennæ and legs brownish yellow. Borders of mandibles and clypeus blackish.

Cayenne (Mayr); Porto Rico: Utuado, Monte Mandios, Coamo Springs.

Redescribed from three females and numerous soldiers and workers taken from several colonies nesting under stones and logs in the open woods and cafetals. The soldier of this subspecies, as Emery has pointed out, may be distinguished from those of other forms of the *flavens* group by the peculiar sculpture of the head, the antennal scrobe being sharply defined laterally by a distinct ruga. The female is remarkably small and dark colored.

31. **Pheidole mœrens** sp. nov.

Plate XII, Figs. 22 and 23.

Soldier. Length 2.5–2.75 mm.

Head large, including the mandibles but little longer than broad, as broad in front as behind, with rather straight sides and moderately deep, angular occipital excision. Occipital depression pronounced, transverse; occipital groove shallow but distinct. Eyes just behind the anterior third of the head. Anterior border of gula with two prominent teeth. Mandibles convex, with a pair of blunt apical teeth. Clypeus flattened, with a distinct median carina, its anterior border sinuately excised in the middle. Frontal area triangular, impressed. Frontal carinæ shorter than the antennal scapes. Scrobe-like depressions very faint. Antennæ slender, scapes reaching to ¼ the distance between the eyes and the posterior corners of the head, curved and slender at the base, incrassated at their tips. Funicular joints 2–8 small, a little broader than long. Thorax through the prominent but rounded humeri about half as broad as the head. Pro- and mesonotum in profile very convex, rounded, the latter somewhat angular behind. Epinotum with subequal base and declivity, the former slightly convex, the latter slightly concave in the middle, with a prominent ridge on each side continuous with the acute spines. These are longer than broad at their bases and directed upward, backward and slightly outward, and are further apart at their bases than long. Petiole suboblong, more than twice as long as broad, with an anteroposteriorly compressed node, which has a long concave anterior and a short, abrupt posterior slope. Its upper border is rounded and entire. Postpetiole half again as broad as the petiole, distinctly broader than long, broader in front than behind, with straight anterior border and prominent but blunt anterior corners. Gaster flattened, as large as the head. Legs rather robust.

Shining; mandibles with very coarse scattered punctures and a few coarse basal striæ. Clypeus longitudinally rugose on the sides. Anterior ¾ of head with sharp longitudinal rugæ, the spaces between which are feebly reticulate, especially in the region of the obsolescent scrobes. Posterior corners of head with a few coarse, widely scattered punctures. Thorax coarsely reticulate rugose, subopaque on the sides; pronotum shining, with a few coarse, transverse rugæ. Petiole and postpetiole more finely punctate-rugulose, subopaque, the latter smooth and shining above. Gaster glabrous, with minute, widely scattered piligerous punctures.

Hairs yellowish, suberect and moderately abundant, both on the body and appendages.

Head and thorax dark brown, almost black; pedicel, gaster, mandibles, clypeus, cheeks and antennæ reddish yellow; legs yellow; border of mandibles and clypeus black.

Worker. Length 1.5–1.75 mm.

Head, excluding the mandibles, a little longer than broad, with straight posterior border and rounded sides. Mandibles with several subequal teeth, those at the apex being but little longer than the others. Clypeus rounded and convex in the middle, with entire anterior border. Antennal scapes reaching a little beyond the posterior corners of the head. Thorax resembling that of the soldier, but with more rounded and sloping humeri, somewhat flatter pronotum and more attenuate epinotal spines. Petiole like that of the soldier but with a more conical node. Postpetiole suboblong, a little broader than the petiole and a little broader than long. Gaster about as large as the head.

Mandibles somewhat shining, sparsely punctate. Head and thorax opaque, densely and coarsely punctate, the front of the former with a few indistinct longitudinal rugæ. Petiole and postpetiole more finely punctate on the sides and below, opaque; the nodes smoother and shining. Gaster glabrous.

Pilosity like that of the soldier.

Head and thorax black, brownish in immature specimens. Gaster dark brown, paler posteriorly; pedicel, mandibles and antennæ brownish yellow; legs somewhat paler.

Culebra; Porto Rico: Utuado, Monte Morales, Monte Mandios.

Described from numerous specimens taken under stones and prostrate plantain trunks in the woods and cafetals. This species evidently belongs to the *flavens* group and is closely related to *Ph. flavens exigua* on the one hand and to *Ph. orbica* Forel and *Ph. dimidiata* Emery on the other. The soldier differs from that of *exigua* in its darker color, and much fainter and indistinctly defined antennal scrobes; from *orbica* in the shape of the postpetiole and to some extent in the shape of the head, which is more rounded on the sides and more glabrous behind; from *dimidiata* in the much shorter postpetiole, much less incrassated femora and less dense longitudinal rugæ on the head. The worker of *mœrens* differs from those of *orbica* and *dimidiata* in the dense opaque sculpture of the head and from that of *exigua* in its darker color and coarser punctation.

32. **Macromischa pulchella** *Emery.*

Emery, Bull. Soc. Entom. Ital., XXVII, 1896, p. 26 (of reprint), ☿ ♀.

St. Thomas (Emery).

33. **Macromischa isabellæ** sp. nov.

Plate XI, Figs. 1 and 2.

Worker. Length 3.5–3.7 mm.

Head rectangular, distinctly longer than broad, with subparallel sides, straight posterior border and eyes a little in front of its middle. Mandibles 5-toothed. Clypeus depressed in the middle, with its anterior border faintly and sinuately excised. Antennal scapes reaching a little beyond the posterior corners of the head; joints 1 and 8 of the funiculus as long as broad, joints 2–7 broader than long, terminal joint of club as long as the two preceding subequal joints together. Thorax nearly three times as long as broad, a little broader in front than behind, with a prominent, straight, transverse ridge across the pronotum, terminating on each side in the angular humerus. In profile the upper surface of the thorax is depressed and evenly rounded, without sutures and without an angle between the base and declivity of the epinotum. Epinotal spines small and blunt, as long as the distance between their bases, directed upward and but slightly backward and outward. Petiole from above more than twice as long as broad, pedunculate and gradually broadening behind, with straight sides; in profile the node is high and rounded, with concave anterior and slightly convex posterior slopes. Postpetiole campanulate, nearly as broad in front as behind, rounded above, less than 1½ times as broad as the petiole and about half as broad as the first gastric segment. Both petiole and postpetiole are distinctly concave beneath in profile, without teeth. Gaster small. Legs long, with incrassated femora, their length and thickness increasing from the first to the third pair.

Opaque; gaster and tibiæ glabrous. Mandibles coarsely longitudinally striated. Clypeus, head, thorax, petiole and postpetiole very finely and densely punctate, so that the surface has a velvety appearance; the clypeus, thorax and middle of the head rather faintly longitudinally rugose, the rugæ on the thorax being further apart than those on the head and those on the clypeus radiating from a point on the middle of the anterior border.

Hairs snow-white, sparse and erect, obtuse and stouter on the thorax, pedicel and gaster; on the antennæ they are more slender and appressed, on the legs reduced to a sparse pubescence.

Mandibles, antennæ, head, coxæ, femora and gaster blue black; the first gastric segment with a brilliant satiny blue reflection, visible only in certain lights. Thorax, petiole, postpetiole and trochanters dull orange red; tips of mandibles, tibiæ, tarsi and two elliptical spots at the base of the first gastric segment, honey yellow.

Female. Length 3.9 mm.

Resembling the worker, but with the following differences in sculpture and coloration: Upper surface of head covered with coarse reticulate rugæ in addition to the dense punctation; pleuræ with much coarser longitudinal rugæ; mesonotum densely and regularly longitudinally rugose. The mesonotum, with the exception of its anterior third, blue black and the pro- and mesopleuræ more or less blackened, especially below. The elliptical yellow spots on the gaster are much larger, being nearly as long as the first segment. The wings are grayish hyaline, with pale brown veins and stigma.

Male. Length 3.5 mm.

Head through the eyes a little broader than long, with rounded, convex posterior portions and very short, concave cheeks. Mandibles small, pointed and dentate. Antennæ long and slender; funicular joints cylindrical, except the first, which is no longer than broad; scapes as long as the first and second funicular joints together. Thorax rather short, as broad through the wing-insertions as the head through the eyes. Mesonotum with deep Mayrian furrows, each crossed by a regular series of short ridges. Epinotum unarmed, sloping, feebly convex. Petiole from above about three times as long as broad, narrowed in front, with subparallel sides behind; node in profile low and rounded. Postpetiole about 1½ times as broad as the petiole, as long as broad, campanulate. Gaster slender, with well developed cerci and genitalia. Legs slender, femora not incrassated.

Opaque; gaster smooth and shining; legs subopaque. Head, thorax and pedicel finely and densely punctate; the sides and posterior portion of the head somewhat reticulately rugulose and the sides of the pronotum with faint longitudinal rugæ. Mesonotum in front with a smooth median longitudinal band.

Hairs whitish, suberect and pointed, sparse on the head, thorax and gaster. Pubescence on antennæ and legs similar to that of the worker.

Black; antennæ and legs fuscous; tarsi and articulations of legs sordid yellow. Wings grayish hyaline, with dull yellowish veins and black stigma.

Summits of Monte Morales and Monte Mandios (about 3000 ft.).

Described from numerous workers, a single female and four males. One of the workers was found running on the leaves of a bush, the remaining specimens were taken from two colonies, one nesting under the roots of an epiphytic orchid, the other in a hollow twig. Both colonies were small, each comprising only a few dozen workers. These moved rather slowly, with the small gaster turned downward and forward between the large hind legs. I take great pleasure in dedicating this the most beautiful of the Porto Rican ants to Mrs. Elizabeth G. Britton. It is clearly distinct from all the described species which show great differences in size, sculpture and coloration.

34. **Macromischa albispina** sp. nov.

PLATE XI, FIGS. 3 AND 4.

Worker. Length 2–2.25 mm.

Head rectangular, longer than broad, as broad in front as behind, with feebly rounded sides, straight posterior border and the eyes just in front of the middle. Mandibles 5-toothed. Clypeus with broadly rounded, entire anterior border.

Antennal scapes reaching to the posterior corners of the head. Funicular joints 2–8 small, much broader than long; terminal joint as long as the two preceding subequal joints together. Thorax short, a little more than twice as long as broad, somewhat broader in front than behind, evenly rounded above and in front, without a transverse postcervical ridge and without sutures. Epinotum with a distinct concave declivity and two acute, tapering spines which are as long as the declivity, longer than their distance apart at the base, directed backward, outward and but slightly upward, and distinctly curved inward and downward at their tips. Petiole three times as long as broad, pedunculate in front and gradually widening behind; node high, laterally compressed and somewhat flattened above, with long, concave posterior slope. Postpetiole fully three times as broad as the petiole, campanulate, broader behind than in front, nearly as broad as the first gastric segment and about twice as broad as long. Gaster small, with broad, straight, anterior border. Legs, especially the hind pair, with incrassated femora, middle femora shorter than the fore pair.

Opaque, very finely and densely punctate, so that the surface has a velvety appearance. Gaster smooth and shining; legs subopaque. Clypeus coarsely longitudinally rugose. Mandibles obscurely striatopunctate.

Hairs snow-white, obtuse and erect, very sparse on the head, thorax and gaster. Legs and antennæ with short, dilute pubescence.

Blue black; first gastric segment with satiny, blue reflections visible only in certain lights. Epinotal spines white. Tip of gaster, frontal carinæ, and mandibles, except the teeth, sordid yellowish; legs and antennæ fuscous, femora and antennal clubs often black or very dark brown.

Female (deälated). Length 4 mm.

Resembling the worker but much larger. Thorax robust, a little more than 1½ times as long as broad and as broad through the wing-insertions as the head through the eyes. Epinotal spines stouter and blunter than in the worker and further apart at their bases than long. Postpetiole nearly three times as broad as long, but considerably narrower than the gaster, which is long and voluminous. Mesonotum covered with fine longitudinal striæ, with a smooth anteromedian and two smooth posterolateral lines. Color and pilosity as in the worker.

Culebra.

Described from thirty workers and a single female, representing a single colony which was found nesting in a small cavity in the ground in the shade of a thicket, where some of the workers were moving about slowly over the dead leaves and twigs. *M. albispina* belongs to the group of small species comprising *M. lucayensis* Forel, *androsana* Wheeler, *pastinifera* Emery, *subditiva* Wheeler, etc.

Emery (Bull. Soc. Ent. France, 1896, pp. 102, 103) was undoubtedly right in eliminating from Roger's genus *Macromischa* all the Old World species that had been assigned to it by Mayr. These species belong, as Emery says, to *Tetramorium.* The American species, whose center of distribution is the Antilles, have a very distinctive and unmistakable habitus. The following table includes the workers of all of the described species of the genus with the exception of *M. lucayensis* Forel of which only a female specimen is known:

1. Species with more or less metallic coloration 15
Species without metallic coloration or merely with violet lustre or reflection on the head or first gastric segment 2
2. Epinotum unarmed 3
Epinotum armed with spines 4
3. Thorax without a mesoëpinotal constriction; thorax and petiole light red; postpetiole, head and gaster black; legs, antennæ, mandibles and anterior border of head reddish brown. Length 5–5.5 mm. (Cuba) . *versicolor* Roger
Thorax with a pronounced mesoëpinotal constriction; light red, with black antennæ and gaster; legs dark brown. Length 7 mm. (Cuba) *punicans* Roger
4. Ferruginous red; epinotal spines very large and long, straight, pointed and divergent 5
Epinotal spines much smaller 6
5. Mesoëpinotal constriction feebly marked; gaster and legs yellowish. Length 4.5 mm. (San Domingo) . . . . *sallei* Guérin
Mesoëpinotal constriction profound; gaster dark brown (Mexico) *cressoni* Ern. André
6. Deep brownish red 7
Of a different or more variegated coloration 8
7. With a brown transverse band on each segment; antennal scapes reaching or barely surpassing the posterior corners of the head. Length 4–4.2 mm. (Panama) . . . . *salvini* Forel
Gaster entirely brown; antennal scapes distinctly surpassing the posterior corners of the head; femora less incrassated; peduncle of petiole longer and more slender. (Panama) . . . . . . var. *obscurior* Forel
8. Largely black species 9
At least the thorax red or yellowish 11
9. Surface of body excepting the gaster, opaque 10
Surface of body shining; small species (2 mm.) ; petiole with a slender peduncle suddenly enlarging behind into an upright anteroposteriorly compressed scale which is but little narrower than the postpetiole (Texas) . *subditiva* Wheeler
10. Large species (6–6.5 mm.); black; head and gaster with faint violet reflections; legs shining, dark brown (Cuba) . . . . . . *lugens* Roger
Small species (2–2.25 mm.); black; with white epinotal spines, laterally compressed petiolar node and very broad postpetiole (Culebra) . *albispina* sp. nov.
11. Surface of body shining; head and gaster black; mandibles, antennæ, thorax, pedicel and legs dilute testaceous. Length 1.5 mm. (St. Thomas) *pulchella* Emery.
Surface of body opaque 12
12. Petiolar node much compressed anteroposteriorly, transverse, suddenly rising from the peduncle, with its upper border curved forward; epinotal spines long and slender, directed backward 13
Petiolar node laterally compressed, gradually rising from the peduncle, with a conical summit; epinotal spines small and erect; head, gaster and femora black; thorax, petiole and postpetiole red; tibiæ and tarsi yellow. Length 3.5–3.7 mm. (Porto Rico) . . . . *isabellæ* sp. nov.

13. Upper border of petiolar node but slightly bent forward; head, postpetiole and gaster black. Length 1.9–2 mm. (Bahamas) . *androsana* Wheeler.
Upper border of petiole much curved forward, both head and thorax red 14
14. Legs shining. Length 2.6 mm. (Bahamas) *pastinifera* Emery (typical).
Legs opaque, finely and densely punctate. Length 2.–2.5 mm. (Bahamas) var. *opacipes* Wheeler.
15. Greater portion of head glabrous, coarsely and longitudinally rugose in front of the eyes; body shining metallic green with violet reflections; nodes of petiole and postpetiole brown, shining, with metallic green or blue reflections; peduncle of petiole and articulations honey yellow; antennal scapes and mandibles brown, funiculus black. Length 4 mm. (Cuba) . . *squamifera* Roger.
Head either densely punctate or longitudinally rugose above . . . 16
16. Head opaque or with a silky luster 17
Head shining 18
17. Head and thorax purplish red, with violet reflections and silky luster; pedicel and legs shining, yellowish brown; gaster black. Length 5–5.5 mm. (Cuba) *porphyritis* Roger.
Head green, with blue and violet reflections; thorax purplish violet with æneous reflections; pedicel yellowish brown, nodes, gaster and femora dark metallic green or brown, very glabrous; tibiæ, tarsi and funiculi lighter brown. Length 5.5 mm. (Cuba) . . . . *iris* Roger.
18. Head shining, violet, thorax red, passing into violet on the pleuræ; epinotal spines, pedicel and legs shining, yellowish brown, gaster black; head with rather widely separated longitudinal rugæ, thorax with coarse irregular rugæ; peduncle of petiole as long as the thorax. Length 5–6 mm. (Cuba) *purpurata* Roger.
Head and thorax deep metallic green, passing into violet on the cheeks, pleuræ and epinotum; mandibles, clypeus, frontal carinæ, neck, terminal tarsal joints and anterior end of petiolar peduncle dull orange; remainder of petiole, postpetiole, gaster and legs black; coxæ, trochanters and extreme bases of femora honey yellow; head with dense longitudinal rugæ, thorax covered with strong, regular arcuate, transverse rugæ; petiole less than half as long as the thorax. Length 3–3.5 mm. (Bahamas) . . . . . *splendens* Wheeler.

35. **Rogeria curvipubens** *Emery.*

Emery, Bull. Soc. Entom. Ital., XXVI, 1894, p. 54 (of reprint). ☿ ♀.

The small ants of the genus *Rogeria* seem to represent a generalized type with affinities to *Leptothorax, Tetramorium* and *Stenamma.* Unfortunately only workers and deälated females are known, so that the precise position of the genus, which must depend to some extent on the venation of the wings, cannot be determined at present. The worker of *R. curvipubens* measures only 1.3–1.75 mm. The head is covered with reclinate curved hairs, the thorax with long sparse pile. The types are from St. Thomas and Bolivia. I have recorded the occurrence of this species also in the Bahamas (Andros Island).

36. **Rogeria foreli** *Emery.*

EMERY, Bull. Soc. Entom. Ital., XXVI, 1894, p. 55 (of reprint), ☿.

This species differs from the preceding in its larger size (2–2.25 mm.), feebler sculpture, the absence of erect hairs on the body and the less shining petiolar node. The types are from St. Thomas.

37. **Tetramorium guineense** (*Fabr.*).

Formica guineensis FABRICIUS, Entom. System, II, 1793, p. 357, no. 31, ☿.
Myrmica bicarinata NYLANDER, Acta Soc. Sc. Fennic., II, 3, 1846, p. 1061, no. 10, ☿ ♀.
Myrmica cariniceps GUÉRIN, Rev. et. Mag. Zool. (2), IV, 1852, p. 79, ☿.
Myrmica kollari MAYR, Verh. zool. bot. Ver. Wien, III, 1853, p. 283, ☿ ♀ ♂.
Tetramorium kollari MAYR, *ibid.*, V, 1855, p. 425, no. 1.
Tetramorium cariniceps ROGER, Berl. Entom. Zeitschr., V, 1861, p. 171.
Myrmica reticulata F. SMITH, Trans. Entom. Soc. London (3), I, 1, 1862, p. 33, ☿.
Tetramorium guineense MAYR, Verh. zool. bot. Ges. Wien, XII, 1862, p. 740, no. 1.

Culebra.

Numerous workers found eating the ripe and broken fruit of the papaw (*Carica papaya*) on Monte Resaca, the highest point of the island.

38. **Tetramorium (Tetrogmus) simillimum** (*F. Smith*).

Myrmica simillima F. SMITH (*nec* Nylander) List Brit. Animals Brit. Mus., Pt. 6, Acul., 1851, p. 118, ☿.
Tetrogmus caldarius ROGER, Berl. Entom. Zeitschr., I, 1857, p. 12, ☿ ♀ ♂.
Myrmica (Leptothorax) simillima F. SMITH, Catalog. Brit. Foss. Hymen., 1858, p. 31, no. 10, ☿.
Myrmica caldaria MEINERT, Naturv. Afh. Dansk. Vid. Selsk. (5), V, 1860, p. 334 no. 28, ☿ ♀ ♂.
Tetramorium simillimum MAYR, Europ. Formicid., 1861, p. 61.

St. Thomas (Forel); Culebra; Porto Rico: Coamo Springs.

In Culebra a few colonies were found nesting under stones and logs on the beach, in Coamo Springs several colonies were seen under stones in the creek bottom near the baths.

39. **Wasmannia auropunctata** (*Roger*).

PLATE XII, FIG. 18.

Tetramorium ? auropunctatum ROGER, Berl. Entom. Zeitschr., VII, 1863, p. 182, no. 74, ☿ ♀ ♂.

Tetramorium auropunctatum Forel, Bull. Soc. Vaud. Sc. Nat. (2), XX, 1884, p. 375, ☿.
Ochetomyrmex auropunctatus Forel, Ann. Soc. Entom. Belg., XXX, 1886, C. R. p. xlix.
Tetramorium (*Xiphomyrmex*) *auropunctatum* Forel, Mitth. Schweiz. Entom. Ges., VII, 10, 1887.
Wasmannia auropunctata Forel, Trans. Entom. Soc. London, 1893, p. 383, ♀ ♂.

Culebra; Porto Rico: Utuado, Monte Morales, Monte Mandios, Adjuntas, Coamo Springs, Morro at San Juan; Vega Baja.

This little ant is common in all the localities above mentioned, nesting under stones, prostrate plantain trunks or logs in shady places, especially in the plantanals and cafetals. The larger dark colored males and females were found in several nests at Utuado and Monte Mandios (March 17 and 20). The workers in a colony are very numerous, and, as indicated by their pale yellow color, lead a hypogæic life. The nests are often established around the roots of plants, and in such situations I have seen the ants attending root-coccids, like the yellow *Lasii* of our northern States.

40. **Cryptocerus atratus** (*L.*).

Formica atrata Linné, System. Natur., Ed. 12*a*, I, 2, 1758, p. 581, no. 15. ☿.
Formica quadridens De Geer, Mém. Hist. Insect., III, 1773, p. 609, no. 7, tab. 31, figg. 17–20.
Cryptocerus atratus Fabricius, System. Piez., 1804, p. 418, no. 1.

St. Thomas (Forel).

It is very doubtful whether this large ant is really a native of St. Thomas. It is more probable that the specimen recorded by Forel had been introduced with plants from the tropical mainland.

41. **Cryptocerus minutus** *Fabr.*

Fabricius, System. Piez., 1804, p. 420, no. 5, ☿.

St. Thomas (Mayr).

42. **Strumigenys membranifera simillima** *Emery.*

Emery, Bull. Soc. Entom. Ital., XXII, 1890, p. 69 (of reprint), tav. viii, fig. 5, ☿.

St. Thomas (Emery).

This subspecies, as Emery admits, is hardly distinguishable from the typical Italian form. "The head is a little narrower, especially in front, more distinctly impressed in the median line behind the clypeus, the antennal funiculus is more slender, with the last joint just perceptibly longer than the preceding joints taken together."

43. **Strumigenys rogeri** *Emery.*

PLATE XII, FIG. 13.

Pyramica gundlachi ROGER, Berl. Entom. Zeitschr., VII, 1862, Pl. I, Fig. 18*a*, ♀ (*nec* ☿).
Strumigenys rogeri EMERY, Bull. Soc. Entom. Ital., XXII, 1890, p. 31 (of reprint), tav. vii, fig. 6, ☿.

St. Thomas (Emery); Porto Rico: Coamo Springs.

Numerous workers and females taken from several colonies nesting under stones in a nearly dry stream bottom behind the Coamo baths. The rediscovery of the female of this species shows that Emery was right in his contention that Roger had described two very different species under the name of *Pyramica gundlachi.* The females among my specimens agree perfectly with Roger's description and figure (Taf. I, Fig. 18*a*).

44. **Strumigenys eggersi** *Emery.*

EMERY, Bull. Soc. Entom. Ital., XXII, 1890, p. 32 (of reprint), tav. vii, fig. 9, ☿ ♀.

St. Thomas (Emery).

45. **Strumigenys louisianæ** *Roger* var. **obscuriventris** var. nov.

PLATE XII, FIG. 14.

Porto Rico: Utuado, Coamo Springs.

This variety differs from the typical form from Florida, Louisiana and Texas in having the gaster, except at the base, dark brown or black, and the ferruginous tint of the body in general darker. At Utuado a few isolated specimens of this variety were found under prostrate plantain trunks in rather damp places. At Coamo Springs several colonies, with their larvæ and pupæ were found nesting under small stones in the same creek bottom as *S. rogeri,* just back of the bath-houses. Misled by Roger's imperfect description, Emery redescribed *louisianæ* under the name of *unispinulosa* (Bull. Soc. Entom. Ital. XXII, 1900, p. 30, Tav. VII, Fig. 5), but he later detected the single preapical mandibular tooth in one of Roger's types and recognized *unispinulosa* as a synonym (Morph. Jahrb. Abth. f. Syst. VIII, 1894, p. 326).

The following table will serve for the identification of the workers and females of the preceding and other American species of *Strumigenys*, with the exception of *S. mandibularis* F. Smith, which was inadequately described, and may be the same as *S. smithi* Forel:

1. Mandibles long and slender, close together at their insertions, with only two borders, an internal and an external, usually parallel or subparallel and overlapped by the clypeus only at their bases 2
   Mandibles shorter, some distance apart at their insertions, with three borders, i. e. with the internal border differentiated into a basal and a more apical (masticatory) border, and over-lapped for a considerable distance by the anterior border of the clypeus 26
2. Inner borders of mandibles without teeth but with a series of minute denticles; (without denticles only in a variety of *eggersi*) 3
   Inner borders of mandibles without teeth and denticles or with a few spine-like teeth 7
3. Antennal scapes suddenly incrassated near the middle; mandibles less than half as long as the head. Length 1.8–1.9 mm. (Brazil) . *crassicornis* Mayr.
   Antennal scapes gradually or not at all incrassated; mandibles more than half as long as the head 4
4. Mandibles straight, at least at the base; distinctly shorter than the head . 5
   Mandibles curved outward just beyond the base and inward near the apex, as long as the head; inner border near the apex with 5–6 denticles; fourth funicular joint 1½ times as long as broad. Length 1.7–1.8 mm. (Brazil) *denticulata* Mayr.
5. Mandibles very slender, gradually tapering to their suddenly incurved tips; a little shorter than the head 6
   Bases of mandibles with parallel sides as far as the middle, then curved outward somewhat; about ¾ as long as the head, with the apical curved inner border minutely denticulate. Length 2–2.2 mm. (Brazil) . . *subedentata* Mayr.
6. Inner apical borders of mandibles with 6–7 minute denticles. Length 1.25–1.3 mm. (St. Thomas) . . . . *eggersi* Emery (typical)
   Inner apical borders of mandibles without denticles; thorax more elongated; epinotal spines shorter; color darker. Length 1.7 mm. (St. Vincent) var. *vincentensis* Forel.
7. Inner borders of mandibles without teeth or denticles 8
   Inner borders of mandibles with at least one subapical tooth . . . 10
8. Mandibles somewhat shorter than the head, parallel, very close together, turned up somewhat at their tips which have an upper simple and a lower bifurcated tooth, all of which are turned sharply inward at a right angle. Length 2 mm. (Cuba) . . . . *gundlachi* Roger.
   Mandibles but little more than half as long as the head . . . 9
9. Pronotum without a median longitudinal ridge. Length 2.2 mm. (Brazil) *imitator* Mayr.
   Pronotom with a median longitudinal ridge. Length 2 mm. (Panama) *elongata* Roger.
10. Inner border of mandibles with a single subapical tooth 11
    Inner border of mandibles with two separated or approximated teeth . 16

11. Mandibles curved outward in the middle, ⅔ as long as the head. Length 1.7–2 mm. (Brazil) . . . . *unidentata* Mayr.

Mandibles straight 12

12. Mandibles only half as long as the head. Body ferruginous. Length 2–2.25 mm. 13

Mandibles more than half as long as the head. Body fuscous, with testaceous mandibles, legs and antennæ (Brazil). Length 3 mm. . *fusca* Emery.

13. Hairs on head squamiform 14

Hairs on head not squamiform, but slender and pointed. Length 2.25 mm. (Bahamas) . . . . *lanuginosa* Wheeler.

14. Antennal scapes reaching only half way between the eyes and the posterior corners of the head 15

Antennal scapes longer. (Bolivia) *louisianæ* Roger var. *longicornis* Emery.

15. Uniformly ferruginous. Length 2.25 mm. (Southern States; Central America) *louisianæ* Roger (typical).

Gaster, except the base, dark brown or black (Porto Rico). var. *obscuriventris* var. nov.

16. Mandibles arcuate, broad, with very convex outer border, especially toward their incurved tips; inner border with two long pointed teeth, of which the proximal is continued back as a somewhat translucent lamina. Length (of female) 5.4 mm. (Panama) . . . . . . *godmani* Forel.

Mandibles straight or slightly curved 17

17. Basal half of inner mandibular border dilated to form a knife-like lamina, beyond which the mandible is suddenly narrowed and furnished with a pair of long spine-like, subapical teeth. Length 3.3 mm. (Brazil) . *cultrigera* Mayr.

Mandibles without a basal dilatation or lamina 18

18. Epinotal declivity on each side without a spine, but with an erect translucent plate or lamina which bears a pair of angles or lobes on its free margin 19

Epinotal declivity without erect laminæ 23

19. Mandibles longer than the head; second funicular joint but little longer than broad, the fourth more than four times as long as broad . . . 20

Mandibles much shorter than the head; second and third funicular joints barely as long as broad, fourth joint barely three times as long as broad 21

20. Length of worker 3.6–3.8 mm.; of female 4–4.2 mm. (Brazil) *saliens* Mayr (typical)

Length of female 4.5 mm.; two preapical mandibular teeth much closer to the apical teeth than in the typical form. (Brazil) . . var. *procera* Emery.

21. Two subapical mandibular teeth of equal length 22

Distal tooth of the subapical pair shorter than the proximal (Brazil) *smithi* Forel var. *inæqualis* Emery.

22. Eyes not strongly convex; length 2.7–3 mm. (Brazil) . *smithi* Forel (typical)

Eyes strongly convex (Misiones) . . . subsp. *prospiciens* Emery.

23. The two subapical mandibular teeth long, closely approximated and near the apical teeth 24

The two subapical mandibular teeth widely separated, the proximal one very small 25

24. Mandibles shorter than the head; antennal scapes not reaching to the posterior corners of the head. Length 1.6 mm. (Antilles) . . . *rogeri* Emery.

Mandibles longer than the head; antennal scapes reaching to the posterior corners of the head. Length 3.8–3.9 mm. (Mexico) . *cordovensis* Mayr.

25. Mandibles nearly straight, with the small proximal tooth near the middle of the internal border. Length 1.7–1.8 mm. (Argentina) . *silvestrii* Emery.
Mandibles slightly curved outward near the middle, with the small proximal tooth near the basal third of the internal border. Length 1.5–1.6 mm. (Brazil) *schmalzi* Emery.

26. Portions of the inner blades of the closed mandibles not covered by the anterior border of the clypeus, denticulate or toothed for only a part of their length 27
Portions of the inner blades of the closed mandibles not covered by the anterior borders of the clypeus, denticulate or toothed throughout their entire length 29

27. Clavate hairs of the anterior clypeal border erect and curved backward. Length 1.6–1.7 mm. (United States) . . . . *ornata* Mayr.
Clavate hairs on the anterior clypeal border directed anteriorly . . 28

28. Length 2.25–2.5 mm.; mandibles just in front of the clypeus with a long pointed tooth; anterior clypeal border with numerous (14–16) clavate hairs; head above covered with whitish squamiform hairs (United States) *pergandei* Emery.
Length 1.5–1.6 mm.; mandibles at the base with a large tooth concealed under the border of the clypeus, which has fewer clavate hairs (10–12); appressed hairs on head not squamiform. (United States) . . *pulchella* Emery.

29. Mandibular border minutely and uniformly denticulate . . . 30
Mandibular border with teeth often of unequal length . . . 32

30. Gaster entirely opaque, reticulate punctate; second and third funicular joints as long as broad. Length 1.8–2 mm. (St. Vincent; Texas) *margaritæ* Forel.
Gaster smooth and shining, at least behind; longitudinally striated in front 31

31. Mandibles short; second and third funicular joints broader than long. Length 1.5 mm. (Pará) . . . . *schulzi* Emery
Mandibles longer; second and third funicular joints as long as broad. Length 2–2.2 mm. (St. Vincent) . . . . *alberti* Forel.

32. Clypeus with straight, transverse anterior border; mandibles as broad as long. Length 1.5 mm. (St. Thomas) . *membranifera* subsp. *simillima* Emery.
Clypeus with rounded anterior border; mandibles much longer than broad 33

33. Clypeus longer than broad; proximal mandibular tooth long and acuminate, separated by a short but distinct sinus from the remaining teeth . . 34
Clypeus not longer than broad; proximal mandibular tooth not acuminate and not separated by a sinus from the remaining teeth 35

34. Clypeus covered with short squamiform hairs. Length 2.5 mm. (United States) . . . . *clypeata* Roger (typical).
Hairs on clypeus curved but not squamiform (United States) var. *pilinasis* Forel.

35. Greatest transverse diameter of head twice that of the clypeus. Length 1.7–1.8 mm. (Brazil) . . . . *frederici-muelleri* Forel.
Greatest transverse diameter of head less than twice that of the clypeus 36

36. Clavate hairs on antennal scapes and clypeus robust and cochleariform. Length 1.8 mm. (Salta) . . . . *conspersa* Emery.
Clavate hairs on antennal scapes and clypeus slender. Length 2–2.5 mm. (United States) . . . . *rostrata* Emery.

46. **Epitritus emmæ** *Emery.*

Plate XI, Fig. 12 and Plate XII, Fig. 17.

Emery, Bull. Soc. Entom. Ital., XXII, 1890, p. 33 (of reprint), tav. viii, fig. 6, ☿.

St. Thomas (Emery).

There is in my collection a winged female of this species from Havana, Cuba (C. F. Baker). It agrees very closely with Emery's description of the worker from St. Thomas. The wings are very hairy, grayish hyaline, with brown veins and stigma. The venation is very much like that of *Strumigenys pergandei* Emery.

47. **Atta (Trachymyrmex) jamaicensis** (*Ern. André*).

Culebra.

Workers, females and males from several colonies. For the synonymy and for detailed taxonomic and ethological descriptions of this and the three following *Attii*, see my recent paper: 'The Fungus-growing Ants of North America,' Bull. Amer. Mus. Nat. Hist., XXIII, 1907, pp. 669–807, pll. xlix–liii, 31 text-figg.

48. **Atta (Mycocepurus) smithi** *Forel* var. **borinquenensis** *Wheeler.*

Porto Rico: Vega Baja, Arecibo, Utuado, Monte Mandios, Coamo Springs.

49. **Cyphomyrmex rimosus minutus** *Mayr.*

St. Thomas (Emery); Culebra; Porto Rico: Arecibo, Adjuntas, Utuado, Monte Mandios, Monte Morales, Coamo Springs.

50. **Myrmicocrypta brittoni** *Wheeler.*

Porto Rico: Santurce.

Subfamily Dolichoderinæ.

51. **Dolichoderus bispinosus** (*Oliv.*).

Formica bispinosa Olivier, Encycl. Method., Insect., VI, 1791, p. 502, no. 60, ☿.
Formica fungosa Fabricius, Suppl. Entom. System., 1798, p. 281, nos. 42 and 43, ☿.

Hypoclinea bispinosa Mayr, Verh. zool. bot. Ges. Wien, XII, 1862, p. 708, no. 8, ♀.
Hypoclinea vestita Mayr, *ibid.*, p. 707, no. 7, ☿.
Monacis bispinosa Roger, Berl. Entom. Zeitschr., VI, 1862, p. 235, no. 2, ☿ ♀.
Polyrhachis arboricola Norton, Proc. Essex. Inst., VI, 1868, p. 4, fig. ☿.
Dolichoderus bispinosus Forel, Bull. Soc. Vaud. Sc. Nat. (2), XV, 1878, p. 386.

St. Thomas (Mayr).

52. **Tapinoma melanocephalum** (*Fabr.*).

Formica melanocephala Fabricius, Entom. System., II, 1793, p. 353, no. 13.
Lasius melanocephalus Fabricius, System., Piez., 1804, p. 417, no. 5.
Myrmica melanocephala Lepeletier, Hist. Nat. Insect. Hymén., I, 1836, p. 185, no. 5.
Formica nana Jerdon, Madras Journ. Lit. and Sci., XVII, 1851, p. 125, no. 44, ☿.
Myrmica pellucida F. Smith, Journ. Proc. Linn. Soc., Zool., II, 1857, p. 71, no. 2, ☿.
Myrmica (Monomorium) pellucida F. Smith. Catalog. Hymen. Brit. Mus., VI, 1858, p. 124, no. 41, ☿.
Formica familiaris F. Smith, Journ. Proc. Linn. Soc., Zool.. IV, 1860, Suppl. p. 96, no. 10, ☿.
Tapinoma melanocephalum Mayr, Verh. zool. bot. Ges. Wien, XII, 1862, p. 651.

St. Thomas (Forel); Culebra; Porto Rico: Arecibo, Utuado, Ponce, Tallaboa.

Several colonies nesting under stones and under the bark of trees. From a single colony on Culebra twenty-two deälated queens were taken.

53. **Tapinoma littorale** *Wheeler.*

Wheeler, Bull. Amer. Mus. Nat. Hist., XXI, 1905, p. 109, ☿ ♀ ♂.

Porto Rico: Monte Morales, Monte Mandios.

A few colonies comprising deälated females, males and workers were found in the hollow twigs of trees and bushes at an altitude of about 3000 feet. These specimens agree very closely with the types from Southern Florida and the Bahamas.

54. **Dorymyrmex pyramicus** (*Roger*) var. **niger** *Pergande.*

Pergande, Proc. Calif. Acad. Sci. (2), V, 1895, p. 871, ☿.

Porto Rico: Santurce, Arecibo, Utuado, Adjuntas, Ponce, Aibonito, Coamo Springs, Vega Baja.

This dark variety of the well-known neotropical *D. pyramicus* is common in sandy and sunny places in nearly all the localities visited in Porto Rico, but could not be found in Culebra.

55. **Iridomyrmex melleus** sp. nov.

PLATE XII, FIGS. 15 AND 16.

Worker. Length 2–2.25 mm.

Head oval, distinctly narrower in front than behind. Mandibles with two larger apical, and numerous minute basal teeth. Clypeal border straight and transverse in the middle, with a slight sinuous excision on each side. Frontal area and frontal groove obsolete. Antennæ slender, scapes surpassing the occiput by about a quarter of their length. Thorax long and narrow, longer than the head with the mandibles, broadest through the pronotum, which is convex and hemispherical, as long as broad. Mesonotum laterally compressed, somewhat less than twice as long as broad, flattened above and lower than the pronotum, separated by a sharp constriction from the epinotum which is bluntly protuberant, with a convex base rising rather abruptly from the constriction, and a somewhat longer and slightly concave, sloping declivity. Seen from above the epinotum is a little longer than broad, and a little broader than the mesonotum. Petiole about half as broad as the epinotum; scale oval from behind, and very distinctly inclined forward, so that its anterior slope is short and abruptly slanting from above backward and downward, its posterior slope much longer and gradually inclined. Gaster small, legs slender.

Surface of body smooth and rather shining, especially above. Mandibles with small scattered punctures.

Pubescence white, rather abundant, but short, covering the body and appendages, longest on the gaster. Pilosity reduced to a few slender, suberect, brown or black hairs on the gaster. In some specimens there are also a few such hairs on the head and thorax.

Honey yellow; gaster and funiculus, excepting its first joint, fuscous. Mandibular teeth and margin of clypeus reddish.

Female. Length 4.5–5 mm.

Head differing from that of the worker in having more prominent posterior, corners and a distinctly and broadly excised posterior margin. Eyes and ocelli large, the former flattened. Thorax through the wing insertions broader than the head through the eyes, narrowed in front and behind, about twice as long as broad. Mesonotum as broad as long. Epinotum thick and convex, with base rounded above and on the sides, passing into the but little sloping declivity without a distinct angle. Petiole short with an erect scale, much compressed anteroposteriorly, its upper border rounded and rather thin. Gaster elongate elliptical. Wings very long (4.5 mm.).

Surface of body and appendages more opaque than in the worker, with denser, longer, white pubescence.

Coloration like that of the worker but the yellow shade is a little deeper and more reddish. There is a small deep black spot on each side of the mesonotum near the insertion of the fore wing, and the base and posterior margin of each gastric segment is yellowish. Wings grayish hyaline, with pale brown veins and stigma.

Male. Length 1.3–1.5 mm.

Head resembling that of the worker, with well-developed, minutely denticulate mandibles, but with larger eyes and prominent ocelli. Antennæ with short scapes which are incrassated and abruptly bent at their tips; funicular joints rapidly decreasing in length distally, the first joint being fully five times as long as broad and as long as the scape, the second joint a little shorter, the terminal joints barely longer than broad. Thorax resembling that of the female, somewhat broader than the head; mesonotum flattened above and not very high above the pronotum. Petiole with an erect, low, thick scale, which is blunt and rounded above. Gaster small, elliptical, flattened above, with prominent rounded genital appendages. Legs slender.

Sculpture, pubescence and coloration like that of the worker. Gaster without hairs. Head infuscated, especially behind. Genitalia yellowish, legs and antennæ whitish. Wings grayish hyaline, with pale gray veins.

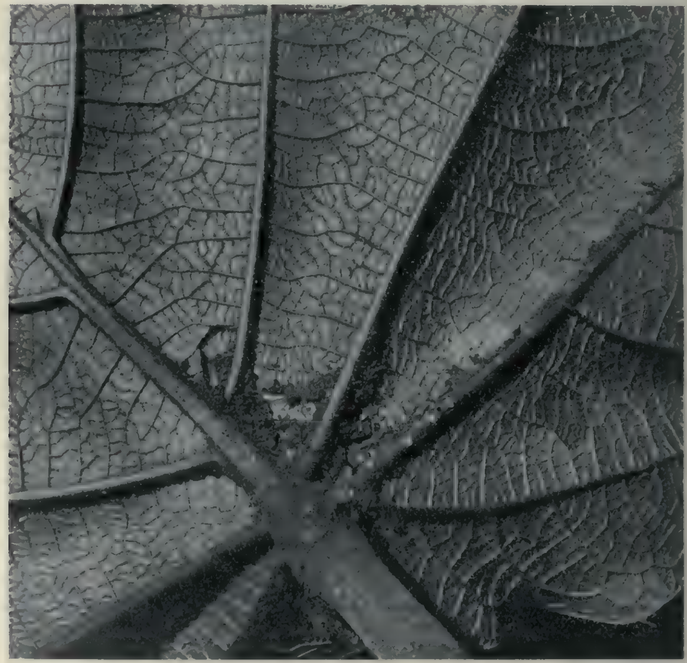


Fig. 3. Nest of *Iridomyrmex melleus* built of earth and vegetable débris along the leaf veins of *Coccoloba rugosa;* about ½ natural size. (Photograph by the author).

Porto Rico: Arecibo, Utuado, Monte Morales, Monte Mandios, Coamo Springs, Vega Baja.

This species belongs to the same group as the other American species of *Iridomyrmex*, viz: *humilis* Mayr, *iniquus* Mayr and *despertitus* Forel, and is very closely related to the two latter, but differs in coloration, smaller size, thinner and more collapsible integument, and in having the petiole lower, longer and more distinctly inclined forward. The thorax, too, is longer and more slender and the epinotum is somewhat less bulky and protuberant. It is not improbable that *Plagiolepis flavidula* Roger of Cuba may be some variety or subspecies of the form here described, but Roger's description is too meager to permit of identification.

I. melleus is one of the commonest ants in the mountains of Porto Rico and is distinctly arboreal. It nearly always nests in hollow twigs. Near Utuado I found it nesting also between the clasping leaf-petioles of plantains, and in the same locality several colonies had built small nests of friable carton (earth mixed with vegetable débris) on the under sides of the huge reniform leaves (sometimes a meter in diameter!) of the "ortegon" (*Coccoloba rugosa*). As these structures, which were built in the angles formed by the thick veins with the leaf-membrane (Fig. 3) contained the brood as well as the ants, they can not be regarded as aphis sheds. The workers of *I. melleus* run very rapidly. They do not have the "Tapinoma odor" so characteristic of many Dolichoderinæ.

56. **Iridomyrmex melleus** var. **fuscescens** var. nov.

Porto Rico: Monte Morales, Monte Mandios.

Workers from a few colonies found in the primeval forests on the summits of these mountains differ from those of the typical *melleus* in having the body and appendages fuscous, the gaster black, the mandibles yellow and the tarsi whitish. In pubescence, pilosity and sculpture they resemble the typical form.

Subfamily CAMPONOTINÆ.

57. **Brachymyrmex heeri** *Forel.*

FOREL, Denkschr. schweiz. Ges. Naturw., XXVI, 1874, p. 91, taf. i, fig. 17, ☿.

St. Thomas (Forel); Culebra; Porto Rico: Santurce, Utuado.

Several workers from small colonies under stones.

58. **Brachymyrmex heeri** var. **obscurior** *Forel.*

FOREL, Trans. Entom. Soc. London, 1893, p. 345, ☿ ♀ ♂.

Porto Rico: Santurce, San Juan.

A darker form of the preceding, with very similar but apparently more epigæic habits.

59. **Prenolepis longicornis** (*Latr.*).

Formica longicornis LATREILLE, Hist. Nat. Fourmis, 1802, p. 113, ☿.
Formica vagans JERDON, Madras Journ. Lit. and Sci., XVII, 1851, p. 124, no. 41, ☿ ♀.
Formica (Tapinoma) gracilescens NYLANDER, Ann. Sc. Nat. Zool. (4), V, 1856, p. 73, no. 34, tab. iii, fig. 20.
Paratrechia currens MOTSCHULSKY, Bull. Soc. Natural. Moscou, XXXVI, 3, 1863, p. 14.
Prenolepis longicornis ROGER, Verz. d. Formicid., 1863, p. 10, no. 313.

St. Thomas (Forel); Culebra; Porto Rico: San Juan, Santurce, Arecibo, Utuado, Adjuntas, Ponce, Tallaboa, Coamo Springs.

Very common in houses, gardens and fields.

60. **Prenolepis vividula** (*Nylander*).

Formica vividula NYLANDER, Acta Soc. Sc. Fennic., II, 3, 1846, p. 900, no. 4. taf. 18, fig. 2, ☿ ♀ ♂.
Prenolepis vividula MAYR, Europ. Formicid. 1861, p. 52; EMERY, Ann. Soc. Entom. Belg., L, 1906, p. 130, figg. 1–4, ☿ ♀ ♂.

Culebra; Porto Rico: Monte Mandios, Monte Morales, Utuado.

The identity of this species, originally described by Nylander from specimens taken in the hot-houses of the botanical garden of Helsingfors and since found in similar places in various parts of Europe, has been recently established by Emery. An examination of Nylander's types from the Helsingfors Museum has enabled him to trace the species to America. He is inclined to regard Mexico as its original home. I had described a very similar form from Texas as *P. melanderi* and this Emery now regards as a subspecies of *vividula*. As a number of workers, two females and two males from the above mentioned localities in Culebra and Porto Rico agree very closely with Emery's description and figures and with my types of *melanderi*, I do not hesitate to assign them to the same species. It is quite probable, therefore, that *vividula* is widely distributed in the West Indies, and that it first reached Europe with orchids and other plants from this source rather than from Mexico.

61. **Prenolepis steinheili** *Forel.*

Prenolepis nodifera FOREL (*nec* Mayr), Mitth. Münch. Entom. Ver., V, 1, 1881, p. 2, no. 2, ☿.
Prenolepis steinheili FOREL, Trans. Entom. Soc. London, 1893, p. 342, ☿.

St. Thomas (Forel); Porto Rico: Adjuntas, Santurce.

Two workers agreeing very closely with typical specimens received from Professor Forel.

62. **Myrmelachista ambigua ramulorum** subsp. nov.

PLATE XI, FIGS. 9 AND 10.

Worker. Length 2-2.3 mm.

Head a little longer than broad, suboblong, with slightly concave posterior border and slightly convex sides. Eyes flattened, near the middle of the head. Mandibles 5-toothed, the first, second and fourth tooth longest. Clypeus narrow, convex, with rounded anterior border, projecting in the middle. Frontal area large, very shallow and indistinct. Frontal groove short. Antennæ short, 9-jointed; tips of scapes reaching only a short distance behind the eyes; first funicular joint nearly as long as the combined four succeeding joints, which are small and much broader than long; terminal joint as long as the two preceding joints of the club together. Pro- and mesonotum hemispherical from above, a little longer than the epinotum; mesoëpinotal constriction pronounced on the sides, shallower above; epinotum longer than broad, narrowed in front, its basal surface somewhat flattened, in profile passing through a rounded angle into the shorter, sloping declivity. Petiole from above 1½ times as long as broad, scale distinctly inclined forward, thick below but becoming more attenuated above in profile; its upper border from behind transverse and feebly excised in the middle. Gaster elliptical. Legs rather stout, with somewhat incrassated femora.

Glabrous and shining. Mandibles subopaque, finely and sparsely punctate. Sides of head with a few coarse, scattered piligerous punctures. Gaster very feebly and finely reticulate.

Hairs yellow, suberect and sparse, longer on the body, shorter on the legs and antennal scapes; on the scapes confined to the anterior surface. Pubescence absent.

Yellowish red; gaster black, with narrow pale margins to the segments; head black behind shading into red on its anterior third. Antennæ and legs yellow; the clubs of the former and the middle portions of the femora, more or less infuscated.

Female (deälated). Length 3.3–3.5 mm.

Head 1½ times as long as broad, oblong, with straight posterior and straight, parallel lateral borders. Eyes large, flattened, a little in front of the middle of the head. Mandibles and antennæ like those of the worker, but the first funicular joint is much shorter than the four succeeding joints together. Thorax regularly elliptical from above, nearly twice as long as broad, broader than the head; in profile flattened above. Epinotum small and sloping, without distinct basal and declivous surfaces. Petiole resembling that of the worker, but with a proportionally lower and much blunter node.

Pilosity like that of the worker.

Color variable, judging from two specimens; in one it is like that of the worker, but with the mesonotum and pleuræ dark brown; in the other (possibly immature) the head and thorax are reddish yellow, with only the ocellar triangle blackened.

Male. Length 2–2.3 mm.

Head through the eyes broader than long, rounded behind, with short cheeks and moderately convex eyes and ocelli. Mandibles with two teeth, the apical smaller and more acute than the basal. Antennæ 10-jointed, resembling those of the worker but with the club 4- instead of 3-jointed; scapes long, first funicular joint incrassated, as long as the three succeeding joints together; three basal joints of club subequal, longer than broad, terminal joints as long as the two preceding joints together. Thorax very broad and robust, nearly twice as broad as the head, elliptical, about 1½ times as long as broad. Mesonotum rounded in front, much higher than the small pronotum, much flattened above and behind. Epinotum small, with a distinct but rounded angle between the subequal base and declivity. Petiole with a low, blunt node. Gaster elongate elliptical, flattened above, with prominent genital valves, the outer pair being triangular, twice as long as broad at the base and rounded at the tip, the median pair slender, linear and directed downward and forward, the inner pair very long, cultrate, directed backward and turned upwards at their tips. Legs slender, femora not incrassated.

Sculpture like that of the worker and female.

Body and appendages, with the exception of the antennal funiculus destitute of hairs and pubescence.

Piceous; mandibles, legs, antennæ, scutellum, petiole and genitalia, except the outer valves, sordid yellow. Wings whitish hyaline, with very pale yellow veins.

Culebra; Porto Rico: Arecibo, Utuado.

This subspecies differs from the typical form of the species, described by Forel from a single worker taken in St. Vincent, in having the body more glabrous and of a much darker color and in the deeper mesoëpinotal constriction. It nests in rather populous colonies in the hollow twigs of trees, especially in the sea-grape (*Coccoloba uvifera*) and "torchuelo" (*Bucida buceros*). The workers move about in long files.

63. **Camponotus ustus** *Forel.*

Forel, Bull. Soc. Vaud. Sci. Nat. (2), XVI, 1879, p. 75, ☿ ♀ ♂.

St. Thomas (Forel); Culebra; Porto Rico: Morro at San Juan, Utuado, Monte Mandios.

This species is rather common, nesting like the allied *C. inæqualis* of the Bahamas and Cuba, in the hollow twigs of the sea-grape (*Coccoloba uvifera*). In Culebra one colony was found nesting in the ground under a block of beach-worn coral. The workers and females, of which a considerable number were collected, agree very well with Forel's description.

64. **Camponotus sexguttatus** (*Fabr.*).

Formica sexguttata Fabricius, Entom. System, II, 1793, p. 354, ♀.
Formica ruficeps Fabricius, System. Piez., 1804, p. 404, ☿.
Formica bimaculata F. Smith, Catalog. Hymen. Brit. Mus., VI, 1858, p. 50.
Formica albofasciata F. Smith, Trans. Ent. Soc. London (3), I, 1862, p. 29.
Formica (*Camponotus*) *ruficeps* Roger, Berl. Entom. Zeitschr., 1862, p. 265.
Camponotus ruficeps Mayr, Sitzb. Akad. Wiss. Wien, LXI, 1870, p. 373.
Camponotus sexguttatus Emery, Boll. Mus. Zool. Torino, IX, 1894, p. 1.

Santa Cruz (Pflug, Fabricius); St. Thomas (Emery); Culebra; Porto Rico: Fajardo (Busck), Morro at San Juan, Coamo Springs.

The female specimen on which Fabricius based this beautiful species, came from Santa Cruz, one of the Virgin Islands. It has since been found to be widely distributed through tropical America. Forel has described its habits and figured its nest in Biologia Centr. Amer. Hymen. III, 1899–1900, p. 155, Pl. II, Fig. 6. "It lives either in hollow twigs of trees and bushes, in bark, or in nests of coarse, loose carton, which it builds around the stems of grasses in the savannahs by agglutinating the thread-like particles of grasses and other débris. These nests are very primitive and not very populous. They resemble the webs mixed with débris constructed by certain spiders. I observed these nests in Martinique, but never in Barbados, where the same species lives in hollow stems and under bark, never in carton." In Culebra and Porto Rico I also failed to find any carton nests of *C. sexguttatus* but found it repeatedly in hollow twigs, especially of the sea-grape. It uses a small amount of carton, however, in constructing at the end of the broken twig a diaphragm which has a round opening to serve as an entrance. Sometimes the diaphragm is flat, (Fig. 4*a*) in other cases produced as a cone (Fig. 4*b*). At Coamo Springs a number of workers were seen on the flowers of *Serjeania lucida*.

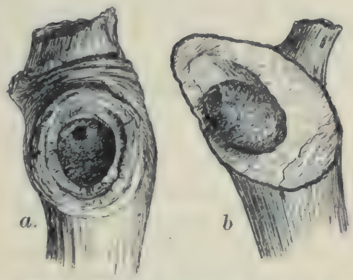


Fig. 4. Ends of broken twigs of Sea-grape (*Coccoloba uvifera*) showing carton diaphragms of *Camponotus sexguttatus* Fabr., with circular entrances.

65. **Camponotus saussurei** *Forel.*

Forel, Bull. Soc. Vaud. Sci. Nat. (2), XVI, 1879, p. 103, taf. i, fig. 3, ☿.

St. Thomas (Forel).

I reproduce Forel's figure (Pl. XI, Fig. 11) of this, the most aberrant of the American *Camponoti*, as it is known from only a single worker. It should be diligently sought by the myrmecologist who has an opportunity to collect in St. Thomas. It measures 4.6 mm. and is black, with the mandibles and tarsi reddish. The body is covered with erect whitish hairs, some of which bordering the petiole and on the flexor surfaces of the femora are described as "thick, rigid and fusiform." It is, in all probability, an arboreal species.

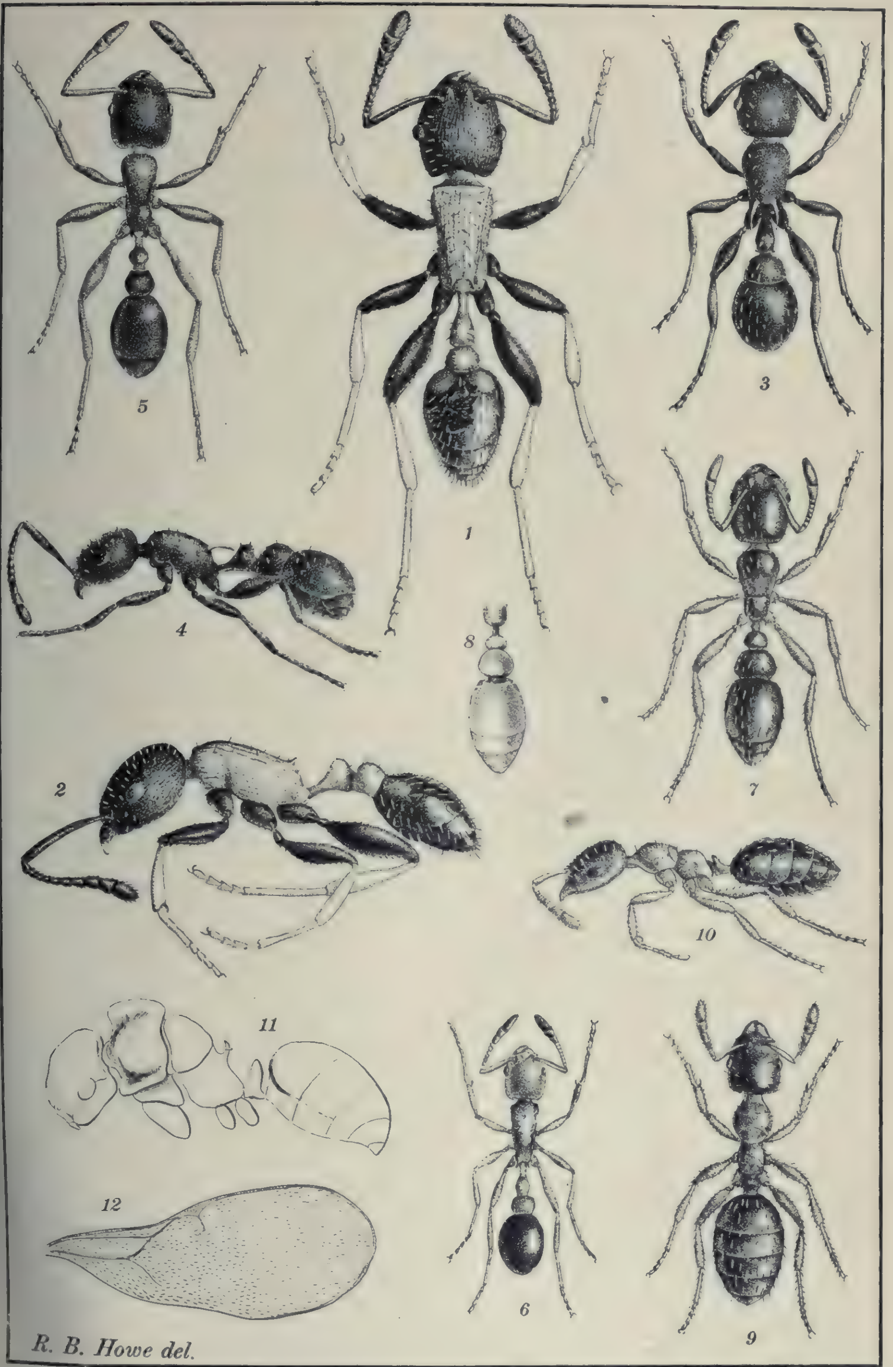
EXPLANATION OF THE PLATES.

Plate XI.

Figs. 1 and 2. *Macromischa isabellæ* sp. nov. Worker.
Figs. 3 and 4. *Macromischa albispina* sp. nov. Worker.
Fig. 5. *Cardiocondyla venustula* sp. nov. Worker.
Fig. 6. *Cardiocondyla emeryi* Forel. Worker.
Fig. 7. *Solenopsis globularia* F. Smith var. *borinquenensis* var. nov. Worker.
Fig. 8. *S. globularia lucayensis* subsp. nov. Abdomen of worker.
Figs. 9 and 10. *Myrmelachista ambigua ramulorum* subsp. nov. Worker.
Fig. 11. *Camponotus saussurei* Forel. Worker. (After Forel.)
Fig. 12. *Epitritus emmæ* Emery. Wing of female.

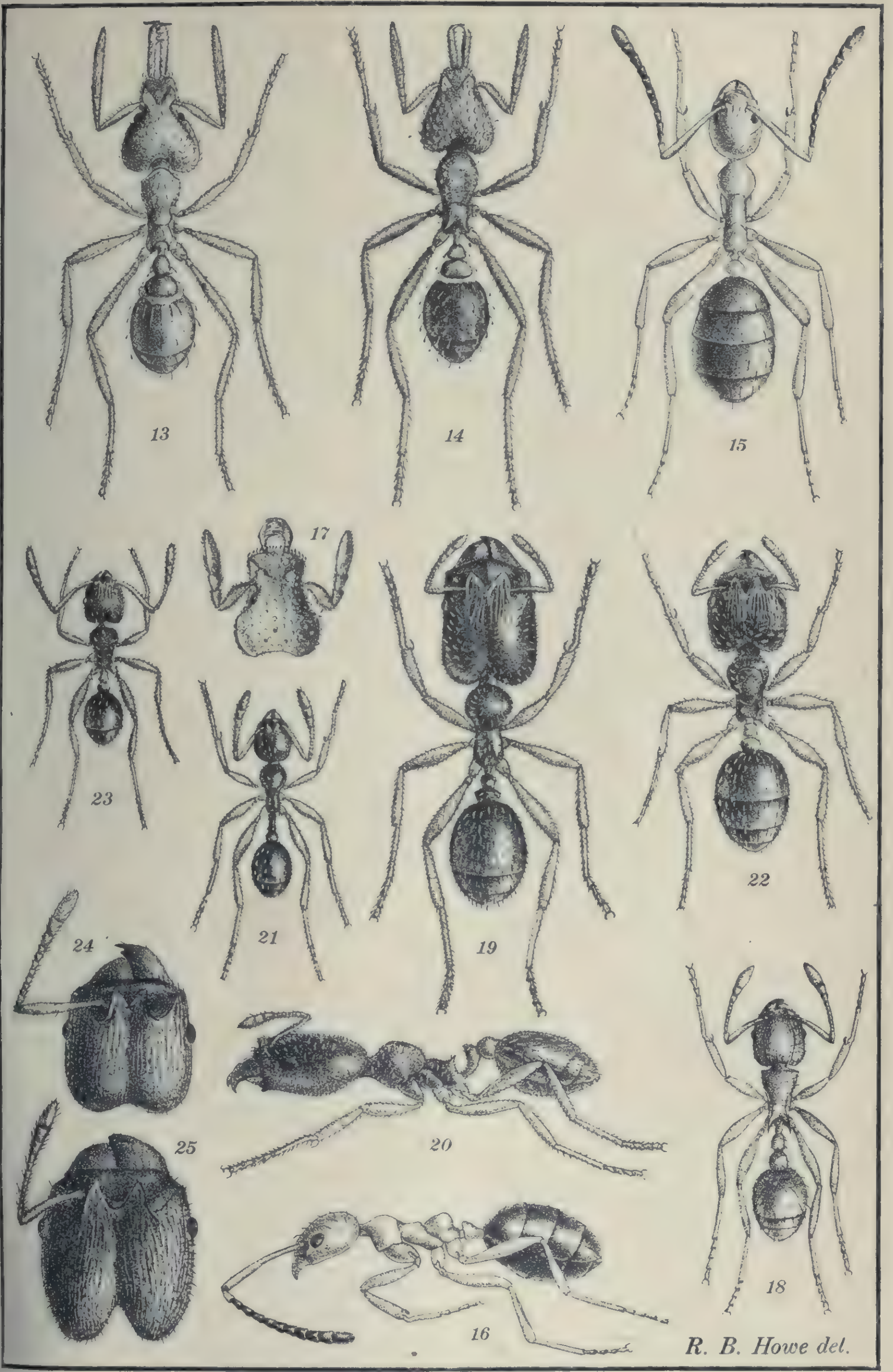
Plate XII.

Fig. 13. *Strumigenys rogeri* Emery. Worker.
Fig. 14. *Strumigenys louisianæ* Roger var. *obscuriventris* var. nov. Worker.
Figs. 15 and 16. *Iridomyrmex melleus* sp. nov. Worker.
Fig. 17. *Epitritus emmæ* Emery. Head of female.
Fig. 18. *Wasmannia auropunctata* Roger. Worker.
Figs. 19 and 20. *Pheidole subarmata* Mayr. var. *borinquensis* var. nov. Soldier.
Fig. 21. Worker of the same.
Fig. 22. *Pheidole mœrens* sp. nov. Soldier.
Fig. 23. Worker of same.
Fig. 24. *Pheidole fallax jelskii* var. *antillensis* Forel. Head of soldier.
Fig. 25. *Pheidole fallax* Mayr (typical). Head of soldier.


5
1
3
4
8
7
2
10
11
12
6
9

R. B. Howe del.

PORTO RICAN ANTS.


13
14
15
17
23
21
19
22
24
20
25
16
18
R. B. Howe del.

Porto Rican Ants.

59.57,96(729.2)

Article VII.— THE ANTS OF JAMAICA.

By William Morton Wheeler.

During the winter of 1905–06 Mr. Alexànder E. Wight of Wellesley Hills, Mass., collected a number of Jamaican ants for the American Museum of Natural History. The collection comprises 22 different forms, 16 of which have not been recorded hitherto from the island. These all belong to known species, but three of them represent new varieties and one a new subspecies. In order to make the list of Jamaican ants as complete as possible, I have included in the following pages also the records of Forel and Ern. André, and have added a few from specimens that have found their way into the Museum collection from different sources. Of the 40 enumerated forms, 9, or nearly 25 per cent., are well-known cosmopolites, and nearly half of the remainder are widely distributed through the West Indies and adjacent South and Central American countries. The Jamaican fauna, so far as known, differs from that of Porto Rico in possessing large species of *Camponotus* (*C. hannani*) of the *abdominalis* group, and in lacking species of *Macromischa*, a genus represented in Cuba, San Domingo, Porto Rico, Culebra, St. Thomas and the Bahamas. The discovery by Mr. Wight of a *Rhopalothrix* in Jamaica adds a new and very interesting genus to the Antillean fauna.

Family FORMICIDÆ.

Subfamily Ponerinæ.

1. **Ectatomma** (**Holcoponera**) **strigatum** (*Norton*).— Kingston (T. D. A. Cockerell, Ern. André), Port Antonio (Wight). Numerous workers from five colonies, with the following notes: "No. 30. Jan. 14. Procession on ground; ants slow-moving; when frightened they hide beneath bits of earth, stone, etc. No. 36. Feb. 6. Procession on ground near mouth of Bog River. No. 45. Feb. 23. Procession on mud, by side of brook; an inactive species. No. 49. Feb. 26. Near mouth of Bog River, nesting under a stone. No. 59. May 3. Procession on the retaining wall of the port."

2. **Platythyrea punctata** (*F. Smith*).— Kingston (Forel).

3. **Odontomachus haematodes** (*L.*).— Kingston (T. D. A. Cockerell, Ern. André); Port Antonio (Wight). Workers from three colonies.

Subfamily MYRMICINÆ.

4. **Pseudomyrma delicatula** *Forel.*— Kingston (Forel). This species is very closely related to *Ps. flavidula* F. Smith.

5. **Pseudomyrma delicatula** var. **capperi** *Forel.*— Kingston (Forel).

6. **Pseudomyrma elongata** *Mayr.*— Port Antonio (Wight). Seven workers taken "from a procession on a tree" have the head and thorax of a rich brown color, paler than in the form which I have recorded from the Bahamas.

7. **Monomorium destructor** (*Jerdon*).— Kingston (T. D. A. Cockerell, Ern. André).

8. **Monomorium omnivorum** (*L.*).— This insect which is mentioned by Browne (Nat. Hist. Jamaica, 1756, p. 440) and other early authors (Linnæus, Fabricius, Gmelin, Christ and Latreille) under the name of *Formica omnivora,* is referred by Dalla Torre (Catalog. Hymen., VII, 1893, p. 68) to the genus *Monomorium,* on the authority of Emery "*in litteris.*" None of the other myrmecologists, who have examined large collections from Tropical America, seems to have recognized the species. Browne's description is too brief and imperfect to throw any light on the subject. C. H. Tyler Townsend stated in the 'Jamaica Post,' Aug. 25, 1893, that this insect is known as the "Tom Raffles" ant, because it was brought to the island from Cuba in October, 1762, by a man of that name, but this date cannot be correct if he refers to the insect described by Browne. Unfortunately Townsend merely mentions the species under its old name *Formica omnivora,* thus leaving the problem of its identity unsolved.

9. **Monomorium floricola** (*Jerdon*).— Port Henderson (Prof. L. H. Clarke); Hope Bay (Wight). Several workers with the note "No. 54. March 8, procession up and down cocoanut palm."

10. **Monomorium carbonarium ebeninum** *Forel.*— "St. Margaret's Bay. No. 41. Feb. 18. Procession on stones near railway station, at sea-level. Port Antonio; No. 44. Feb. 23. Nesting among roots of orchid on tree." (Wight.)

11. **Cardiocondyla emeryi** *Forel.*— Kingston (C. Gagzo, Forel).

12. **Solenopsis geminata** (*Fabr.*).— Kingston (T. D. A. Cockerell, Ern. André); Port Antonio (Wight).

13. **Solenopsis azteca** *Forel* var. **pallida** *Wheeler.*— Port Antonio (Wight). Numerous workers from two colonies with the notes: "No. 24. Bank of Bog River, feeding on fungus on cocoa-nut stump; No. 58. Apr. 28, nesting in rotting log." These specimens agree perfectly with the types of the variety from Porto Rico.

14. **Pheidole fallax** *Mayr.*— Kingston (Forel).

15. **Pheidole megacephala** (*Fabr.*).— Kingston (Forel).

16. **Pheidole punctatissima jamaicensis** subsp. nov. "Valley, off shore road, 2½ miles west of Port Antonio. Nesting in rotting log." (Wight.)

The soldier of this form is very similar to that of the subsp. *insulana* Wheeler from the Bahamas, but differs in the following characters: The rugæ on the front and sides of the head are stronger, the extrême posterior corners are less shining, the pronotum is coarsely reticulately rugose above, the lateral conules of the postpetiole are sharper and more acuminate, and the head, thorax and pedicel are dark brown in color. The coloration of the worker, too, is much deeper than in *insulana*.

17. **Pheidole radoszkowskii** *Mayr* var. **opacissima** *Forel.* —Willard House, Kingston (Forel).

18. **Pheidole subarmata** *Mayr.* — Port Antonio (Wight). Several workers with the note: "Dec. 22. Nest in path, with small mound of particles of earth." These workers are pale in color like those of the typical form of the species.

19. **Cremastogaster vicina** *Ern. André.*— Moneague (T. D. A. Cockerell; Ern. André).

20. **Cremastogaster vicina** var. **wighti** var. nov.— St. Margaret's Bay. "Feb. 26. Procession on ground in woods." (Wight.) Several workers which agree well with André's description of *C. vicina* except in color. The head, thorax and pedicel are dark chestnut brown, the legs and antennæ a little paler, the mandibles yellow, the gaster black. The typical form has "the head light brownish red; the antennæ, thorax and legs sordid reddish yellow; the gaster more or less deep chestnut brown; sometimes the head is lighter and of the same color as the thorax." Perhaps a variety of this ant still darker than the variety *wighti* exists in Jamaica and may be the one described as "formica minor nigerrima sylvatica, abdomine triangulari," by Sir Hans Sloane (A Voyage to the Islands of Madera, Bardadoes, Nieves, St. Christopher's and Jamaica, etc. 1725, II, p. 222).

21. **Cremastogaster victima** (*F. Smith*) var. **steinheili** *Forel.*— Kingston, "in twigs" (Forel); Port Antonio (Wight). A single winged female, " No. 29. Jan. 7. Flew to light in evening."

22. **Tetramorium guineense** (*Fabr.*).— Road to Shotover, 2 miles west of Port Antonio, "nest in ground under a piece of wood." (Wight.)

23. **Wasmannia auropunctata** *Roger.*— Port Antonio (Wight). Numerous workers of the typical, smooth, Antillean form of this species, from two colonies, with the notes: "No. 5, Nov. 29, nest in dead bark on ground, under stone near sea-shore; No. 37, Feb. 6. Nest among dead leaves."

24. **Rhopalothrix simoni** *Emery* var. **wighti** var. nov.— Road to Shot-

over, 2 miles west of Port Antonio, about 500 feet altitude (Wight). "The ants, which were gathered with their brood in a cavity on the under side of a stone, acted dazed when the stone was turned and, when they were more disturbed, simulated death." The specimens which are all workers, agree closely with Emery's description of *R. simoni* from Venezuela but are decidedly larger (2 mm.). This is the first *Rhopalothrix* to be taken in the West Indies, all the other members of this singular genus having been collected on the adjacent continent.

25. **Atta (Trachymyrmex) jamaicensis** *Ern. André.*— Jamaica (Fox, Ern. André).

26. **Cyphomyrmex foxi** *Ern. André.*— Jamaica (Fox, Ern. André).

27. **Cyphomyrmex rimosus minutus** *Mayr.*— Lowlands near Bog River, Port Antonio (Wight). Two deälated females and five workers with the note: "No. 21, under bark of cocoanut log."

Subfamily DOLICHODERINÆ.

28. **Tapinoma melanocephalum** *Fabr.*— Kingston (T. D. A. Cockerell, Ern. André); Port Antonio (Wight). Numerous workers from two colonies with the notes: "No. 7. Nov. 30, under bark of a tree; No. 22. Dec. 26, procession on piazza of house."

29. **Forelius maccooki** (*Forel*).— Kingston (Forel).

Subfamily CAMPONOTINÆ.

30. **Brachymyrmex minutus** *Forel.*— Mouth of Rio Grande River (Wight). Several workers, with the note: "No. 47. Feb. 26, under stone."

31. **Brachymyrmex heeri** *Forel* var. **obscurior** *Forel.*— Mouth of Rio Grande River (Wight). Several workers with the note: "No. 50. Feb. 27, under stone."

32. **Prenolepis fulva** *Mayr.*— Port Antonio (Wight). Numerous workers from two colonies, with the notes: "No. 27. Jan. 7, attending aphids on shrub. No. 28. Jan. 7. Running in a partly covered passage up trunk of cocoanut palm."

33. **Prenolepis longicornis** (*Fabr.*).— Port Antonio (Wight). Numerous workers with the note: "No. 46. Feb. 25. Procession in dwelling; movements very rapid."

34. **Camponotus capperi** *Forel.*— Jamaica (Capper, Forel). The worker of the type of this beautiful species has the epinotum sharply angular in profile, the gaster yellowish brown, with a narrow dark brown band

across the posterior portion of each segment. The pilosity and pubescence are long and abundant, especially on the gaster.

35. **Camponotus capperi corticalis** *Forel.*— Kingston, Botanical Garden (Forel). This subspecies has the gaster concolorous with the head and thorax, and the epinotum, humeri and posterior corners of the head are much less angular in the worker major.

36. **Camponotus capperi corticalis** var. **subdepilis** var. nov.— Port Antonio (Wight). "May 3. Procession on the retaining wall." A worker major, media and six minor workers agreeing closely with types of *corticalis* in color, but the white hairs on the body are much fewer, more erect and less flexuous. On each gastric segment they are reduced to three sparse rows. The pubescence is like that of *corticalis.*

37. **Camponotus fugax** *Forel.*— Kingston, Botanical Garden (Forel).

38. **Camponotus conspicuus** *F. Smith.* — Kingston (Forel); Port Henderson (Prof. L. H. Clarke).

39. **Camponotus hannani** *Forel.*— Kingston, Botanical Garden (Forel); Port Antonio; Shotover (Wight). Major workers, mediæ and minor workers from five colonies, with the following notes: "No. 18. Dec. 20. Golden Vale road; running on cocoanut log; No. 10. Dec. 7, ants huddled together in horizontal hole near base of a telephone pole; No. 25. Jan. 5, crawling on tree; No. 26. Jan. 5, nest in decayed fence post; ants very fierce; No. 56. March 20; Shotover, East bank of Rio Grande, ants in rotting log, fierce and rapid of movement." All of the specimens agree very closely with types from Kingston received from Prof. Forel. This is in all probability the species described by Sir Hans Sloane (l. c. p. 222) as "formica major rubra."

40. **Camponotus hannani willardi** *Forel.*— Jamaica (Capper, Forel, Fox); Moneague (Dr. F. C. Paulmier). Forel described only the minor worker and media of this subspecies. A soldier from the Philadelphia Academy collection (Fox) and four soldiers, a media and worker collected by Dr. Paulmier enable me to add the following notes: The hairs on the body are more erect and quite as abundant as in the typical *hannani,* but much more abundant on the inferior surface of the head and much longer on the antennal scapes and legs. The surface of the body is more shining in all the worker forms. As Forel has pointed out, the head of the worker minor is much shorter, broader and less rounded behind, with nearly straight posterior border.

59.57,96(96.2)

Article VIII.— ANTS FROM MOOREA, SOCIETY ISLANDS.

By William Morton Wheeler.

During the winter of 1906–1907 a collection of ants was made for the American Museum on the little island of Moorea (Eimeo), near Tahiti, in the Society group by Mr. G. A. McTavish. The collection comprises 13 species, all of small size. Five of them (*Monomorium pharaonis, Solenopsis geminata, Plagiolepis longipes, Prenolepis longicornis* and *Tapinoma melanocephalum*) are well known cosmopolites; three others (*Tetramorium pacificum, Technomyrmex albipes* and *Prenolepis obscura*) seem to have a wide distribution among the South Sea Islands; three species of *Pheidole* cannot be identified as they are represented only by single sexual individuals; one species (*Ponera perkinsi*) has hitherto been recorded only from the Sandwich Islands; and one (*Plagiolepis mactavishi*), closely related to certain Indian and East African species, is here described for the first time.

Subfamily Ponerinæ.

1. **Ponera perkinsi** *Forel.*— Several winged females agreeing well with Forel's description of the types from Hawaii. Without the workers, however, the identification must remain somewhat doubtful.

Subfamily Myrmicinæ.

2. **Monomorium pharaonis** (*L.*).— Six deälated females and numerous workers.

3. **Solenopsis geminata rufa** (*Jerdon*).— Several major and minor workers of the typical red color and with a prominent mesosternal tooth.

4. **Pheidole** sp.— A deälated female allied to *Ph. megacephala* and perhaps belonging to a subspecies of this form, but not to be identified without the soldier.

5. **Pheidole** sp.— A single winged female, measuring only 4 mm.

6. **Pheidole** sp. A single male, too small to be the male of No. 4 and too large to belong to No. 5.

7. **Tetramorium pacificum** *Mayr.*— One deälated female and five workers.

Subfamily Dolichoderinæ.

8. **Tapinoma melanocephalum** (*Fabr.*).— Several workers.
9. **Technomyrmex albipes** (*F. Smith*).— Eight workers and a male.

Subfamily Camponotinæ.

10. **Plagiolepis longipes** (*Jerdon*).— Numerous workers.

11. Plagiolepis mactavishi sp. nov.

Worker. Length 1–1.25 mm.

Head a little longer than broad, as broad in front as behind, with convex sides and distinctly excised posterior border. Clypeus carinate. Antennal scapes reaching a little beyond the posterior corners of the head; joints 2 and 3 of funiculus very small, broader than long; succeeding joints a little longer than broad, except the last, which is as long as the three preceding joints taken together. Thorax from above fully three times as long as broad, shaped like that of *P. pygmæa*, *i. e.*, hourglass shaped when seen from above, with deep mesothoracic constriction especially on the sides. This constriction is marked on the dorsal side by a transverse groove which divides the segment into two pieces of nearly equal size and of similar shape. Pronotum somewhat hemispherical; epinotum truncated behind and nearly as broad as the pronotum; in profile with subequal base and declivity, the former rounded, the latter flattened or concave and sloping. Petiole small and narrow, with its node much inclined forward, its upper border acute in profile, transverse and entire when seen from behind. Gaster larger, elongate elliptical, not very pointed at the tip. Legs of moderate length.

Surface of body smooth and shining.

Pubescence and hairs white; the former sparse, most conspicuous on the head and appendages; the hairs few in number, long, suberect and confined to the clypeus and gaster.

Honey yellow; the gaster and appendages a little paler; teeth of mandibles, thoracic sutures and two spots on the postero-lateral corners of the first gastric segment, dark brown.

Described from 10 workers.

This species is closely related to *P. exigua* Forel of India and to *P. alluaudi* Emery and *brunni* Forel of Eastern Africa. *P. exigua* is darker in color than *mactavishi*, has shorter antennal scapes and a shorter thorax, with more angular humeri and narrower epinotum. In *alluaudi* the antennal scapes and thorax are much longer, the petiole has a rounded upper border and the two brown spots on the first gastric segment are much larger. *P. brunni* is larger than *mactavishi*, with rounded petiolar border, and dark markings (spots or bands) on the posterior portions of all the gastric segments. *P. brunni* and *alluaudi* also have the antennal funiculi infuscated towards the tip and more robust.

12. **Prenolepis longicornis** (*Latr.*).— Eight females and numerous workers.

13. **Prenolepis obscura vaga** *Forel*.— Three workers and two winged females. The former agree very closely with a type specimen from the Bismarck Archipelago received from Professor Forel. The females measure 4 mm. The body is smooth and shining especially on the mesonotum, and covered with gray pubescence which is most abundant on the head and gaster. Pilosity and color as in the worker. Wings slightly smoky, with pale brownish veins and stigma.

Article IX.— ANTS FROM THE AZORES.

By William Morton Wheeler.

The Azores have acquired a peculiar interest in the study of chorology as types of what Wallace called "oceanic" in contradistinction to "continental islands." This eminent naturalist, in his volume on 'Island Life' (p. 246 *et seq.*), has shown that the fauna of these islands is almost exclusively European in character, notwithstanding the fact that they are situated nearly 900 miles from the coast of Portugal and are enclosed by the 1000 fathom line, "while a depth of 1800 fathoms is reached within 300 miles in all directions." "These islands," he says, "lie in the course of the southwesterly return trades and also of the Gulf Stream, and we should therefore naturally expect that American birds, insects and plants would preponderate if they were conveyed by the regular winds and currents, which are both such as to prevent European species from reaching the islands. But the violent storms to which the Azores are liable blow from all points of the compass; and it is evidently to these, combined with the greater proximity and more favorable situation of the coasts of Europe and North Africa, that the presence of a fauna and flora so decidedly European is to be traced."

Wallace's views were based mainly on the plants, birds and beetles collected in the Azores. I was therefore very glad of an opportunity, while on a trip to Europe during the past summer, to collect ants in San Miguel, the largest island of the group. The steamer stopped for only part of a day at Ponta Delgada, and I hastened to the open country near the fortress of San Blas west of the quaint little town. My search for Formicidæ proved to be rather disappointing, however, as a three hour's scrutiny of the surface of the soil yielded only the following four well-known species:

1. **Ponera eduardi** *Forel.*— A single colony comprising six or seven workers nesting under a large stone.

2. **Monomorium carbonarium ebeninum** *Forel.*— Two colonies, under stones.

3. **Tetramorium caespitum** (*L.*).— Very common under stones, blocks of larva, etc., and also in nests with diffuse or multiple craters. This species was represented by two varieties, one larger and darker, like the form common in rich moist soil in Europe, and the other smaller and redder, like the variety met with on xerothermic hillsides in Switzerland and Italy.

4. **Lasius niger** (*L.*).— Like the preceding very common under stones and blocks of larva and running over the ground in files. All the specimens

seen belonged to the typical, large, dark-colored European form, with hairy legs and antennal scapes.

Three of these species are clearly of European origin, and one, the *Monomorium,* is of neotropical provenience. It has been recorded from Madeira, however, and may have spread to the Azores from this island. *Ponera eduardi* also occurs in Madeira, the Canary Islands and along the entire shore of the Mediterranean. In all probability there are several other species of ants in the Azores, but the few above recorded certainly confirm the conclusions reached by Wallace from a study of the plants, birds and beetles.

59.9,51B:14

Article X.— NOTES UPON THE EXTERNAL AND INTERNAL ANATOMY OF *BALÆNA GLACIALIS* BONN.

By Roy C. Andrews.

On February 22, 1907, two specimens of the North Atlantic Right Whale, *Balæna glacialis* Bonn., were captured off the southern coast of Long Island, New York, near the villages of Amagansett and Wainscott. Both animals were females, one being adult and the other young. As they were beached just at the edge of low tide where surf was continually breaking over them, investigations were carried on with the greatest difficulty, and we were able to obtain but comparatively few external measurements. However, an opportunity was given for considerable study upon the fresh skeleton. For convenience in reference I have arranged the following notes in the order adopted by True in his monograph on 'The Whalebone Whales of the Western North Atlantic.'

External Characters.

Size.— The length of the Amagansett whale at the time of capture was given me by the whalers as 56 feet and 7 inches taken with a tape laterally, from the tip of the snout to end of the "flukes." When I arrived the flukes had been removed and the peduncle severed in two places, but the lengths of the several sections gave a total of 54 feet from the tip of the snout to the notch of the flukes, along the mid-dorsal line.

The Wainscott whale was lying belly up and was measured in a *straight* line from the tip of the snout to the notch of the flukes. Hence the lengths of the two specimens are unfortunately not directly comparable.

External Measurements.

	Amagansett.	Wainscott.	Amagansett.	Wainscott.
	Feet	Feet Inches	%[1]	%[1]
Total length of whale	54	40 3	100	100
	Inches	Inches		
Tip of snout to eye (straight)	150	103	23.1	21.3
" " " " occipital condyle	192	120	29.6	24.8
" " " " posterior end of baleen	173	—	26.6	—
" " " " anterior end of bonnet	24	—	3.7	—
"Small" to caudal bifurcation	—	58	—	12.0

---

[1] Reduced to per centum to agree with True.

	Amagansett. Inches	Wainscott. Inches	Amagansett. %	Wainscott. %
Breadth of "small"	—	20	—	4.1
Depth of "small"	—	33	—	6.8
Tip of mandible to end of condyle (straight)	159	—	24.5	—
Maximum depth of lower lip	68	—	10.	—
" thickness of lower lip	27	—	4.1	—
Flukes, tip to tip	—	160	—	33.1
Breadth of right lobe (notch to posterior margin)	49	44	7.6	9.1
Length right lobes of flukes axially	92	89	14.2	18.4
Pectoral from tip to insertion	86	—	13.4	—
" " " " head of humerus	98	90	15.1	18.7
" greatest breadth	46	47	7.09	9.7
" " " at insertion	37	37	5.7	7.6
" thickness at insertion	16	—	2.4	—
" greatest thickness of posterior margin	4	—	.6	—
Length of blow-hole axially	10	8.50	1.5	1.7
Divergence posteriorly	14.50	12.25	2.2	2.5
" anteriorly	3.75	2.75	.5	.5
Breadth of bonnet	12	9	1.8	1.8
Length of "	18	12	2.7	2.5
Longest whalebone (excluding bristles)	77	36?	11.8	—
Greatest breadth base of whalebone	9	—	1.3	—

Color.— Both individuals were partly flensed when I examined them, but in each case the skin of one side and of the back was practically intact. The Wainscott whale externally was everywhere dense ivory-black, showing not the slightest indication of lighter color, either on the fins or flukes, or even on those portions of the body infested by parasites.

The Amagansett whale was of the same color with the exception of the flukes and flippers and the region immediately surrounding the genitalia, where there were numerous milk-white patches varying in diameter from two to fourteen inches.

On the flukes of this specimen, from the tips for a considerable distance along the posterior border, there were narrow streaks and patches of white, showing on both the inferior and superior surfaces. The pectorals also were strongly marked with white in large patches, particularly on the inferior surface along the posterior margin. Anteriorly and on the superior surface the white areas were greatly reduced in size and number, generally taking the form of narrow streaks. These white areas were perfectly healthy and there was no indication of former injury or the presence of parasites.

Inasmuch as all hitherto recorded American specimens of this species, according to True, with one exception, have been black, this variation in color is noteworthy. A photograph of a whale, undoubtedly an example of *B. glacialis*, captured at Amagansett, Long Island, N. Y., in March, 1897,

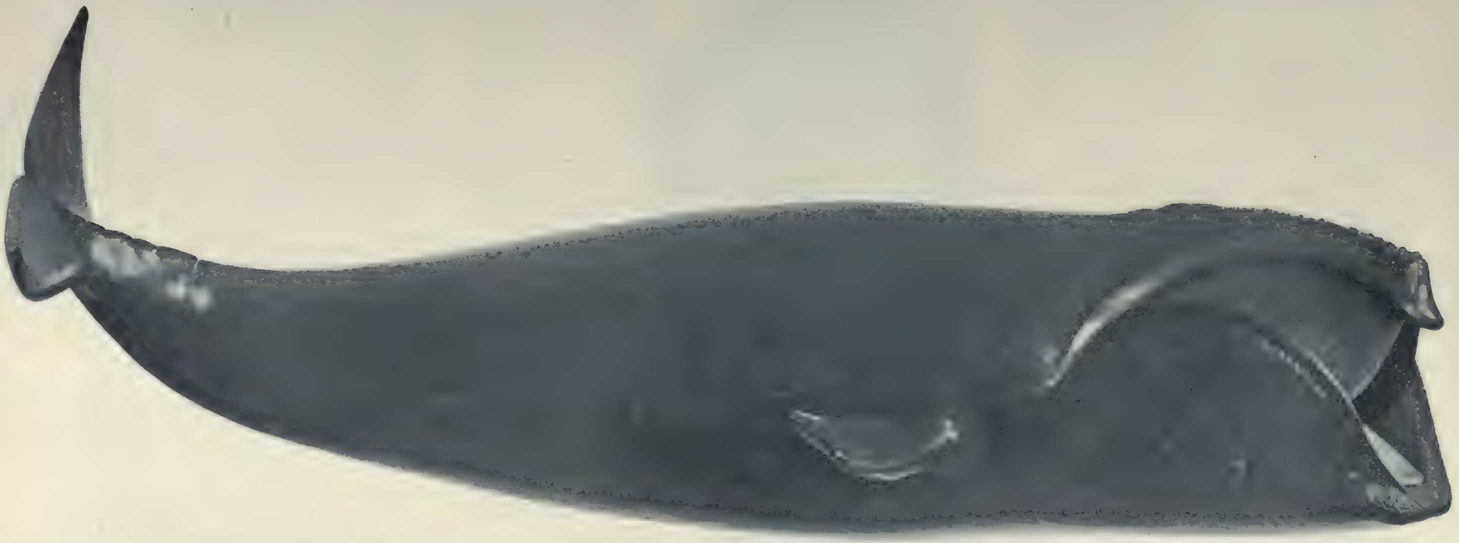


Fig. 1. Model of Amagansett whale: Scale 1 inch to 1 foot. Modeled by Mr. James L. Clark.

shows the left pectoral to be strongly marked with white along the posterior edge. Capt. J. B. Edwards of Amagansett, who has had a life-long experience as a whaler, says in a letter: "I have seen several Right Whales with white markings or spots on the sides, and some with the breast and throat nearly all white." In this connection Dr. True remarks: "The Cape Lookout specimen, captured March 20, 1894, a female, was said to be a 'white bellied' one. The figure published in the *Bulletin of the North Carolina Dept. of Agriculture* (14, No. 7, April, 1894, p. 4) shows the whole under surface light colored, from a point in advance of the eye to the anus, the white area extending up to the base of the pectorals and having irregular margins. If the drawing was correctly made from the specimen itself, it indicates a remarkable color variation. In a letter Mr. H. H. Brimley remarks that this specimen had 'a great deal of pure white on its under side.'"[1]

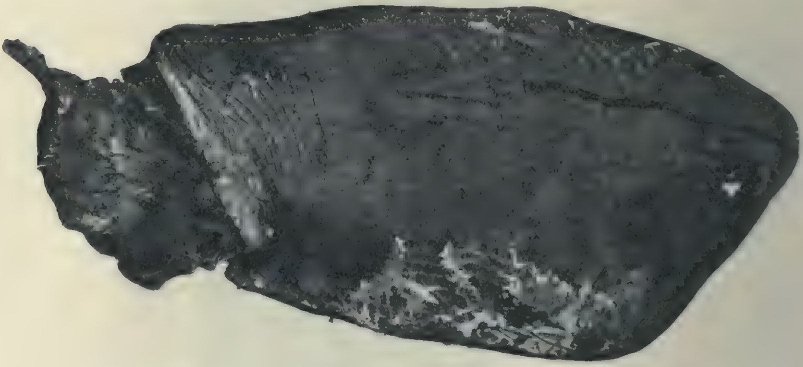


Fig. 2. Inferior surface of left pectoral fin of Amagansett whale.

It would seem, then, that this species is subject to considerable color variation.

Head.— The anterior portion of both the Amagansett and Wainscott whales presented the same general appearance. The mandible of the former specimen from tip to end of condyle, in a straight line, measured 13 feet and 3 inches. On the inner side of the *right* ramus there was a large shallow depression extending well into the bone and pure white in color — probably the scar from some old wound. The lower lip of this whale had a maximum depth of 5 feet and 8 inches, its greatest thickness being 27 inches, and was strongly crenulated along the superior and posterior margins. Its interior surface was a light bluish-gray, uneven in tone, the light and dark colors giving a slightly mottled effect. The mucous membrane of the roof of the mouth was a delicate pink or flesh color.

---

[1] Whalebone Whales of Western North Atlantic, p. 250.

The "bonnet" of the Amagansett specimen measured 18 inches in length by 12 inches in breadth, its posterior margin being extended along the superior median line of the rostrum to within a short distance of the anterior ends of the blow-holes, forming an irregular ridge, the average width being 5 inches. On both rami of the mandible, and at a point directly above the eye, numerous rough protuberances of the same character as the bonnet were to be found. All of these protuberances were thickly infested by Amphipod crustaceans (*Cyamus* sp. ?).

The region of the spiracles was only slightly elevated above the general level of the head, the blow-holes themselves having an axial measurement of 10 inches, diverging anteriorly 3¾ inches, and posteriorly 14½ inches.

Between the tip of the snout and the anterior end of the bonnet, 150 white hairs, each about one half inch long, were counted. In the region of the mandibular symphysis there were about the same number, but the rest of the head was absolutely naked.

Baleen.— The baleen of the Amagansett specimen, including both plates and bristles, was deep blue-black in color, with the exception of the anterior portion, where for a distance backward of 18 inches, the bristles and extreme bases of the plates were pure white. The gum externally and between the plates was zinc white. The longest plate of whalebone from gum to tip, exclusive of the bristles, measured 6 feet 5 inches, its greatest basal breadth being 9 inches. The bristles were exceptionally abundant for this species, and reached in some instances a length of 10 inches. I was unable to measure the baleen of the Wainscott whale as it had been removed before I arrived, but the whalers stated that it was not more than 3 feet in length.

Flukes and Pectoral Fins.— The flukes of both specimens were convex anteriorly, having acuminate, slightly recurved tips and an open, rather shallow notch. The posterior border was noticeably convex near the notch, and then nearly straight to within a short distance from the tips where it became slightly concave. The left fluke of the Amagansett whale evidently had been injured at the tip, which was blunt and rounded and eight inches shorter than that of the opposite side.

The pectoral fins presented the characteristic angular form. The anterior border was irregularly convex, but posteriorly the margin formed a wide and blunt obtuse angle, the distal arm of which was short and nearly straight, the proximal being longer and very slightly convex.

Eye.— The eyeball of the Amagansett whale measures 3¼ inches antero-posteriorly, and 3 inches in vertical diameter. These measurements, however, were taken from the preserved specimen after the eyeball had been trimmed of adhering matter. The iris of clear brown is surrounded by a narrow irregular ring of lighter color and measures 2¼ inches on the long axis. The pupil is elliptical, slightly flattened laterally, its longitudinal diameter being 1¼ inches. Parallel to the optical orifice, above and below, were two deep depressions or furrows 7 inches in length.

OSTEOLOGY.

Vertebræ.— The following vertebral formulæ of the Amagansett and Wainscott whales show only a slight variation in the number of caudals.

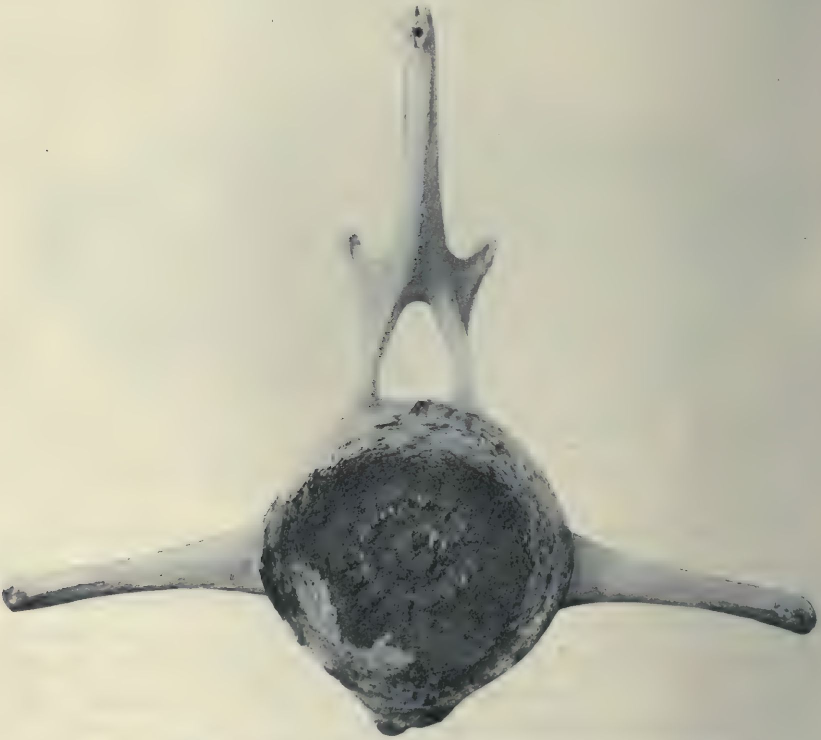


Fig. 3. Posterior view of first caudal vertebra of Amagansett whale.

Amagansett,	C 7	D 14	L 11	Ca 24
Wainscott,	C 7	D 14	L 11	Ca 23

The cervical vertebræ of the two individuals correspond closely. The neural arches of the sixth and seventh cervicals of the Wainscott whale are united, these vertebræ being entirely free from the preceding ankylosed cervicals, except at the distal end of the left diapophysis and the inferior portion of their centra.

In the Amagansett specimen only the neural arch of the seventh cervical is free, the remainder, viz.: the entire centrum and the transverse processes at the distal ends, being ankylosed.

Recognizing the fact that there is considerable question as to the correct number of lumbar vertebræ which may be assigned to this species, all the caudal vertebræ with their attached chevrons were sent to the Museum in the flesh. Subsequently these were carefully numbered under my personal supervision, thereby precluding any possibility of error in the location of the first chevron and the precise determination of the lumbar units. Although in both specimens the posterior end of the inferior median carina was distinctly widened upon the 32d vertebra, yet the 33d vertebra was the first to bear a chevron and is thus denoted as the first caudal. (It is true that the chevrons had been removed roughly from the caudals of the Wainscott whale before they were transferred to the Museum and I was unable to examine them *in situ*, nevertheless every indication led me to believe that they corresponded with those of the Amagansett specimen).

Measurements of the skeletons and other relative data are appended in the following tables.

Measurements of Skeletons of Amagansett and Wainscott Whales.

	Amagansett.	Wainscott.	Amagansett.	Wainscott.
	Feet	Feet Inches	%[1]	%[1]
Total Length of whale	54	40 3		
	Inches.	Inches.		
" " " skull (straight)	163	110	100	100
Greatest breadth of atlas	30	23.50	18.4	21.3
" depth " "	17	17	10.4	15.4
Length of diapophysis of atlas	8	5.75	4.9	5.2
Height of neural spine of atlas	4	4.50	2.4	4.09
Greatest breadth of 1st dorsal (posterior)	27.50	21.25	16.8	19.3
" depth " " " "	22.50	17.50	13.8	15.9
Depth of centrum " " " "	9	7.75	5.5	7.04
Breadth of " " " " "	11	10	6.7	9.09
Length of diapophysis of 1st dorsal (posterior)	11	6.50	6.7	5.9
Height of neural spine of 1st dorsal	5.50	3.25	3.3	2.9
Greatest breadth 1st lumbar	44.50	33	27.3	30.0
" depth " " (posterior)	27	19.25	16.5	17.5
Depth of centrum " " "	10	8.25	6.1	7.5
Breadth of centrum 1st lumbar "	12.50	11	7.6	10.0
Length of diapophysis 1st lumbar	16	11	9.8	10.0
Height of neural spine " "	12.50	6.50	7.6	5.9

---

[1] Reduced to per centum to agree with True.

	Amagansett. Inches	Wainscott. Inches	Amagansett. %	Wainscott. %
Greatest breadth of 1st caudal	36	24.50	22.0	22.2
" depth " " " (posterior)	30	22.50	18.4	20.4
Depth of centrum " " " "	13	12	7.9	10.9
Breadth of centrum of 1st caudal (posterior)	13.25	12.25	8.1	11.1
Length of diapophysis 1st caudal	13	6.50	7.9	5.9
Height of neural spine " "	12	8	7.3	7.2
Length of humerus (including epiphyses)	22	19	13.4	17.2
Length of radius (excluding ")	21	19	12.8	17.2
Length of ulna (" ")	18	16.25	11.0	14.7
Neural spine ends on vertebra	No. 45	No. 44		
First vertebra with transverse process perforated by vertical foramen	No. 39	" 38		
Transverse processes end on vertebra	" 42	" 41		
Anterior zygapophysis first definitely separated on vertebra	No. 15	" 17		

Skull. The proportionate variations in the two skulls shown by the measurements given in the appended table are relative in all probability to the extreme youth of the Wainscott specimen:

	Amagansett.	Wainscott.	Amagansett. %[1]	Wainscott. %[1]
		Feet Inches		
Total length of whale	54	40 3		
	Inches	Inches		
Length of skull (straight)	163	110	100	100
Greatest breadth (orbital)	102	76	62.5	69.0
Length of rostrum (straight)	134	91	82.2	82.7
Breadth of rostrum at middle (curved)	20	14	12.2	12.7
Anterior end of nasals to end of rostrum (on curve)	127	82	77.9	74.5
Breadth of orbital processes of frontals at distal ends	11	9.50	6.7	8.6
Length of nasals (median)	10	9	6.1	8.1
Breadth of 2 nasals distally	10	9.50	6.1	8.6
Length from tip of rostrum to anterior orbital margin (straight)	137	94	84.0	85.5
Length of mandible (straight)	154	106	94.4	96.3
" " " (curved)	170	122	104.0	110.9
Depth of mandible at middle	12	9	7.3	8.1
" " " at coronoid	18	13.50	11.0	12.2

Scapula.— The differences in the scapulæ of the respective specimens are minor and confined chiefly to the acromion. In the Amagansett scapula this is long, strongly curved, and much contracted distally. In the Wainscott whale it is but slightly depressed and shows little curvature. The distal end is somewhat thickened and the proximal width is continuous throughout its entire extent. The right scapula of both animals is somewhat broader than the left. Measurements are given in the following table:

---

[1] Reduced to per centum to agree with True.

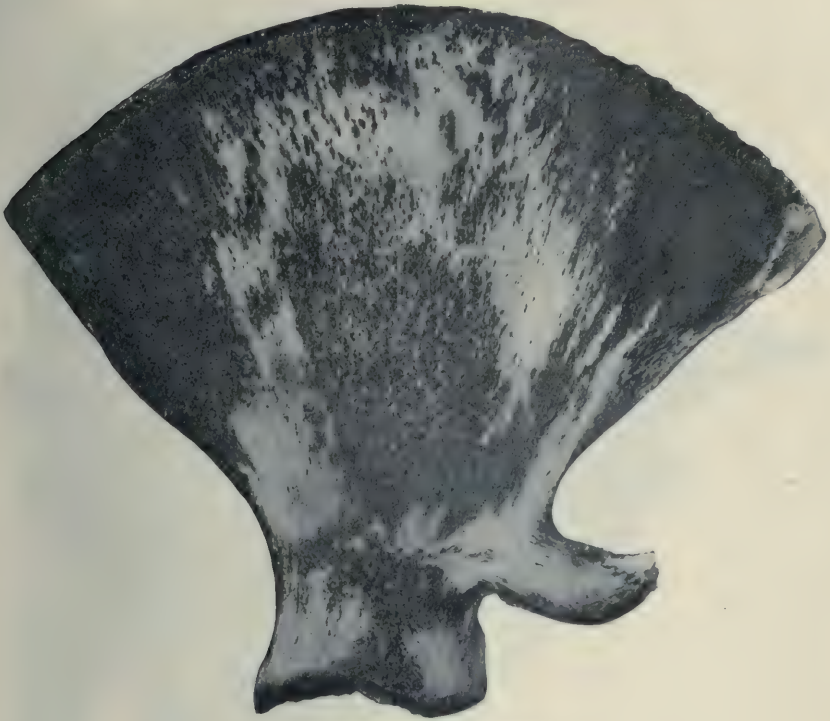


Fig. 4. Scapula of Amagansett whale.

Amagansett.

	Right. Inches.	Left. Inches.
Greatest breadth	47.25	45
" height	38	37.50
Length of acromion	9.50	9.50
Breadth of glenoid fossa	13	12.75

Wainscott.

	Right. Inches.	Left. Inches.
Greatest breadth	36.25	34.50
" height	26.75	26.75
Length of acromion	5.75	5.75
Breadth of glenoid fossa	11.75	11.50

Carpals.— The number and size of the carpal bones in the respective flippers of the two specimens differ materially. In the right carpus of the Amagansett whale, five distinct ossifications were found; the left carpus had four. In the Wainscott specimen there were four ossifications in the right and three in the left carpus. These bones in both individuals were irregularly rounded in shape and composed of soft cancellous tissue, their relative sizes varying decidedly. The positions of these structures, so far as they were represented by ossifications, remained constant.

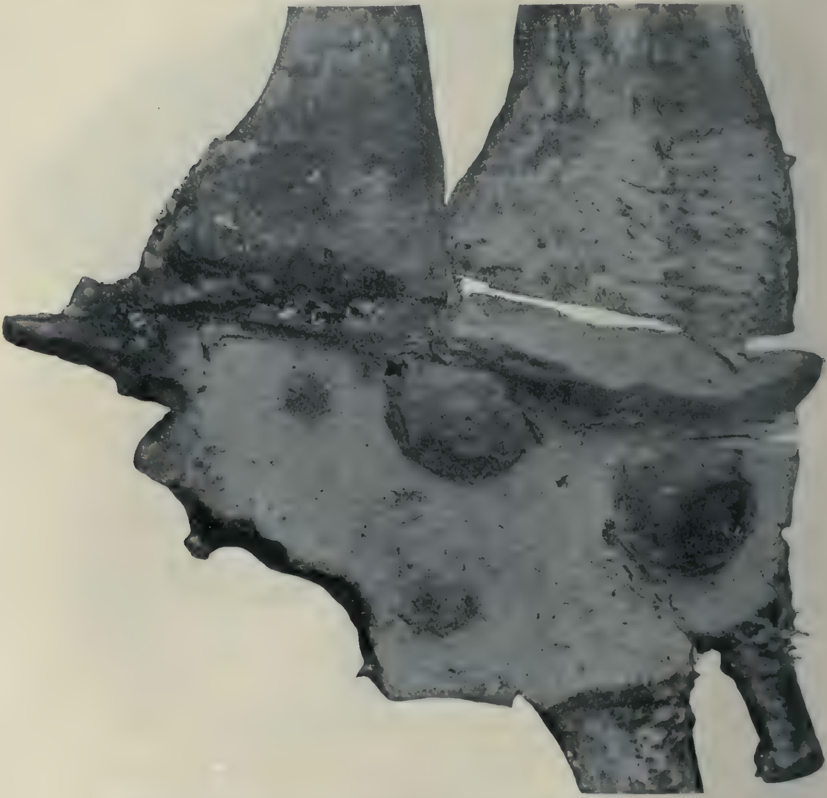


Fig. 5. Right carpus of Wainscott whale, showing ossifications.

Phalanges.— The formula for the phalanges of the Wainscott specimen, the dissections having been made in the laboratory, is as follows: Wainscott I_1 II_4 III_5 IV_4 V_0.

Unfortunately the flippers of the Amagansett whale were disturbed in transit, but from an examination of a cast taken soon after the specimen reached the Museum, I am convinced that the formula would correspond with the Wainscott series above given. Although this formula agrees with that of none of the skeletons in American museums as shown by True, it is certainly correct. Moreover, True has stated that as the series of phalanges in all the mounted American skeletons is incomplete, he was not able to give a reliable formula.

Chevrons.— The number of chevrons present in the two individuals shows a marked variation. Twelve were found in the Amagansett whale, and nine in the smaller Wainscott specimen. This discrepancy is due in all probability to the decided difference in the ages of the two animals. The first chevron of the Amagansett series is considerably smaller than those immediately succeeding, and has no spinous process, the lateral laminæ being free and somewhat contracted at the distal ends. The fifth chevron is the largest, measuring 11½ inches in length, the spinous process being 8 inches wide. As the series of chevrons in all exhibited American skeletons is apparently incomplete, and as these were examined *in situ*, this observation may prove of value in further study of the species.

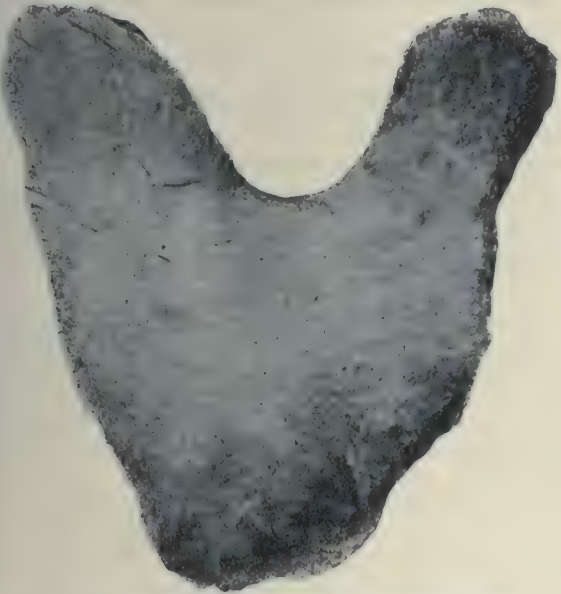


Fig. 6. Dorsal view of sternum of Amagansett whale.

Ribs.— The ribs of each specimen number fourteen. The first is single headed, its length in a straight line and breadth distally being given in the table below. A considerable difference between the two sides of the skeleton of each individual was apparent, the ribs throughout, as well as practically all the bones of the right side, being larger in varying degrees.

	Breadth.		Length.	
	Right. Inches.	Left. Inches.	Right. Inches.	Left. Inches.
Amagansett	10.25	8.50	55	52.50
Wainscott	5.50	5.25	39	36

CONCLUSIONS.

The results of the preceding notes may be summarized as follows:

1. The Amagansett whale exceeds in size the largest specimen hitherto recorded.
2. Considerable color variation in the species is a fact.
3. The number of lumbars for *B. glacialis* is normally eleven.
4. The formula for the phalanges is I_1 II_4 III_5 IV_4 V_3.
5. The number of chevrons is twelve.
6. The carpal bones, which ossify very late in life, are subject to considerable variation in the respective flippers of a single individual.
7. There is bilateral asymmetry in both examples, the right side being larger.

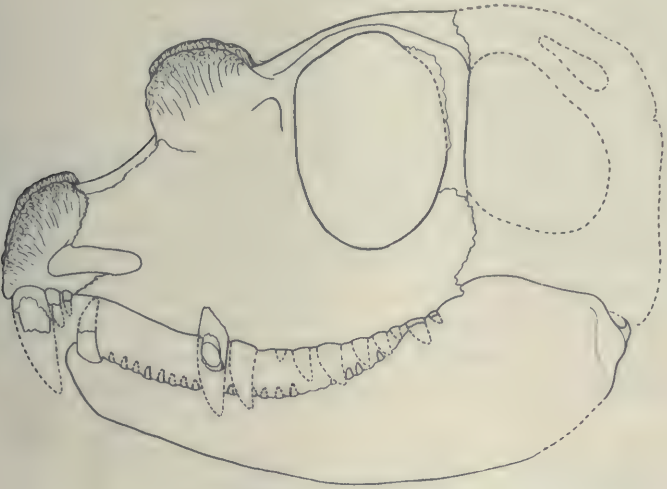
56.81, 7T(115:76.4)

Article XI.— A FOUR-HORNED PELYCOSAURIAN FROM THE PERMIAN OF TEXAS.

By W. D. Matthew.

Tetraceratops insignis gen. et sp. nov.

The collections of Permian vertebrata brought together by the late Professor Cope are now being catalogued, arranged and prepared for exhibition and study at the American Museum under direction of Prof. Henry F. Osborn. While engaged upon this work the writer came across a skull which appears to represent a new and remarkable genus of Pelycosauria. The specimen, No. 4526 Am. Mus., Cope Coll., was collected by Mr. Charles H. Sternberg in 1897 in the Permian beds of Baylor County, Texas. It consists of a fairly complete skull about ten centimeters long with one ramus of the lower jaw complete. The temporal arches of the right side are gone and the whole specimen is somewhat crushed laterally and partly buried in a hard matrix.



Tetraceratops insignis, natural size.

The most noticeable feature is the presence of two pairs of prominent bony bosses or "horns," one rising from the premaxillaries, the other from the prefrontals. These bosses project upwards from the skull, are laterally compressed, longer than high, rugose toward the tips and were probably crowned with a horny cap.

The premaxillaries bear a pair of large caniniform tusks set near together and projecting downwards, followed by two or three small teeth. Behind them is a diastema of 17 mm. to the enlarged maxillary canine. Behind the canine is a row of 9 or 10 smaller teeth, the last three laterally compressed, and rapidly decreasing in size. The dentition appears to be much as in *Dimetrodon* except that the caniniform teeth are more differentiated in the new genus and the curvature of the tooth line much less, especially at the diastema.

The orbit is remarkably large and much further forward than in *Dimetrodon* and the borders are not so prominent; its vertical diameter is nearly one half greater than the horizontal. The face is high and compressed, the top of the skull very narrow. The temporal and occipital region is comparatively massive, with certainly one large postorbital fenestra, but in the present state of preparation of the type its structure cannot be clearly seen, and the presence or absence of a second temporal fenestra is not demonstrable. The pterygoid has a short massive transverse bar with two large external teeth and several smaller internal ones; in *Dimetrodon* there is a transverse row of moderately large teeth of uniform size. The palatal plates of the pterygoid are buried in matrix, the quadrate plate is broad and flat, its relations apparently as in *Dimetrodon*. The epipterygoid is a slender rod broadening out below into a thin plate sutured to the quadrate plate of the pterygoid; its junction with the parietal is destroyed by weathering.

The lower jaw has one or two enlarged caniniform anterior teeth and behind them a row of compressed pointed teeth, much smaller and more numerous than the maxillary series. The form of the jaw is not unlike that of *Dimetrodon* except that the articular region is not depressed as in that genus.

The Pelycosaurian affinities of the new genus appear in:

1. Differentiation of the teeth, with enlarged premaxillary and maxillary tusks separated by a diastema for the mandibular tusk, remaining teeth simple, pointed, laterally compressed, the mandibular series smaller.
2. High narrow skull, rimmed orbit.
3. Heavy transverse bar on pterygoid, with comparatively large teeth set along it.

The above specializations differentiate the typical Pelycosauria from the primitive Diapsidan or two arched type represented by the Protorosauria. They are further distinguished by the great elongation of the neural spines of the vertebræ, but these are unknown in the new genus. In *Dimetrodon* the articular region of the jaw is much depressed and the adjoining parts of the skull much extended downwards; the curvature of the tooth row is much greater and the orbit much farther forward. In these respects the new genus is far more primitive. On the other hand, the relative enlargement and specialization of the caniniform teeth on premaxillary, maxillary, dentary and pterygoid is further advanced in *Tetraceratops*. The peculiar "horns" are not indicated in *Dimetrodon* or *Clepsydrops*, nor in any of the more primitive genera which Case has included under the order Pelycosauria. Among reptiles the nearest approach to them is seen in the carnivorous Dinosaurs *Ceratosaurus* and *Allosaurus*. In both genera the prefrontals have bony horns similar to those of *Tetraceratops* but more rudimentary. In *Ceratosaurus* a median nasal horn is also present between the premaxillaries. As the carnivorous Dinosaurs have a very considerable adaptive resemblance in the skull to the Pelycosauria, combined with a more remote genetic relationship, the parallelism is not surprising. The skull has a considerable superficial resemblance to that of the Oligocene artiodactyl *Protoceras*.

From the relationship to *Clepsydrops* and *Dimetrodon* it may be inferred that the vertebral spines of *Tetraceratops* were probably elongated into a high dorsal fin. I have not seen in the collections any vertebræ of this type which appeared small enough to be of appropriate size. As the genus is evidently a highly specialized predaceous adaptation, the skull would probably be of relatively large size to the skeleton, and should be correlated with long-spined vertebræ of smaller size than those with the less specialized and somewhat larger skull of *Clepsydrops natalis*. But the skeletal association must remain conjectural for the present.

59.9, 53M(931)

Article XIII.— DESCRIPTION OF A NEW SPECIES OF *MESOPLODON* FROM CANTERBURY PROVINCE, NEW ZEALAND.

By Roy C. Andrews.

Plate XIII.

Mesoplodon bowdoini sp. nov.

Among the Cetacean specimens in the American Museum of Natural History, is the skeleton of a *Mesoplodon* (No. 35027) apparently representing a species hitherto undescribed. It was collected at New Brighton Beach, Canterbury Province, New Zealand, in 1904. The sutures of the skull are all closed and the terminal epiphyses of the vertebral bodies are completely ankylosed, in most cases their lines of union being indistinguishable. The mesethmoid or "mesorostral" cartilage is also densely ossified throughout its entire extent. Therefore, the specimen must be adult. The sex is unknown, but I believe it to be a male.

This specimen is evidently closely related to *M. bidens*, and the allied *M. europæus*, its skull agreeing fairly well in general proportions with those species as figured by Van Beneden and Gervais in their "Ostéographie des Cétacés."[1] Measurements of the skull are given in the appended table, and also the ratio of the length of the different parts to its total length; with these are compared the corresponding ratios for the skulls of *M. bidens* and *M. europæus* based on the above-mentioned figures given by Van Beneden and Gervais.

Measurements of Skull.

	M. bowdoini.		*M. europæus.*	*M. bidens.*
	mm.	%	%	%
Extreme length of cranium	715	100	100	100
Length of rostrum (from line between bottoms of *real* max. notches)	428	59.8	60.4	62.5

---

[1] Ostéographie des Cétacés, plates XXVI and XXIV.

	M. bowdoini.		*M. europæus.*	*M. bidens.*
	mm.	%	%	%
Height from vertex to lower border of pterygoids	311	43.6	35.2[1]	37.5
Length from tip of rostrum to posterior free margin of pterygoids (median)	563	79.0	——	——
Length from tip of rostrum to crest over anterior nares	490	68.5	78.0	75.0
Breadth between centers of orbits	325	45.4	44.4	40.8
" " zygomatic processes of squamosal	335	46.8	48.4	42.5
Breadth between temporal fossæ	208	29.0	——	——
" " post-orbital processes of frontals (greatest)	345	48.2	48.8	42.9
Breadth of rostrum at base between bottoms of *real* max. notches	193	26.9	28.8	31.2
Breadth of rostrum at middle	52	7.2	9.2	7.5?
Depth of rostrum at middle	73	10.2	6.8	5.8
Greatest breadth of anterior nares	65	9.0	——	——
" " " premaxillæ proximally	167	23.3	23.2	18.7
" " " " in front of nares	112	15.6	14.8	15.0
Greatest length of temporal fossa	120	16.7	14.0	12.5
" depth " " "	80	11.1	10.0	9.1
Height from middle of orbital rim to top of max. crests	53	7.4	——	——
Breadth of orbit (antero-posterior)	95	13.2	12.0	15.4
Length of tympanic bulla	51	7.1	——	12.0
Breadth " " "	41	5.7	——	9.1
Length of mandible	628	87.8	88.0	87.5
" " symphysis (superior)	146	20.4	18.0	25.0
Depth of mandible at angles	127	17.7	15.2	14.1
" " " " coronoid	115	16.0	12.0	15.0
Distance from condyles to posterior margin of tooth	395	55.2	72.0	55.2
Least depth of mandible behind tooth	65	9.0	8.0	7.5
Length exposed portion of tooth (anterior)	90	12.5	4.0	8.7
" " " " " (posterior)	69	9.6	6.0	5.4
Ant.-posterior breadth base of tooth (intern.)	75	10.4	——	——

SKULL. *Superior View.*— There are three maxillary foramina approximately level with the foramen in the premaxillæ. The rostrum contracts gradually toward its distal end. Proximally it passes into the cranium by a widened base formed by the lateral expansion of the maxillaries. These maxillary flanges extend forward along the lateral surfaces of the rostrum for only its proximal fourth. The edges of the maxillæ overlying the orbital processes of the frontals are greatly thickened in our specimen, forming two prominent convex ridges or crests which curve inward anteriorly to meet the outer borders of the maxillary tuberosities. The posterior extension of these tuberosities forms on either side a second ridge, running parallel to the first, but much shorter, thicker and more rounded at the crest. Our specimen somewhat resembles *M. hectori* in this respect, and disagrees with *M. bidens* and *M. europæus.* The antorbital notches are double and deep. Posteriorly the premaxillæ rise almost perpendicularly on either side of the anterior nares; their proximal ends are strongly everted, completely overhanging the opening. Both are directed obliquely backward; the right and larger of the two has a deep sinus running across it transversely, ending in a vertical foramen between it and the maxilla. The sinus on the left side is indistinct. From the right premaxillary foramen a groove extends forward and upward, almost reaching the suture between the mesorostral and premaxillary ossifications; on the left side this groove is wanting. Immediately in front of the foramina, the premaxillæ begin to assume a nearly vertical position, continuing thus to the end of the rostrum. The nasal bones are sunk between the proximal ends of the premaxillaries, the right nasal alone, because of its greater development, reaching the vertex. The densely ossified mesorostral bone appears between the edges of the premaxillæ on the superior surface of the rostrum, throughout its extent, the exposed portion being widest at the rostral base; here it is 22 mm. in breadth. It ends proximally in a thin ridge of bone directed upward. The mesorostral has two shallow grooves on its superior basal surface, and a well defined median groove at its distal end.

---

[1] Posterior margin of pterygoids probably broken.

Posterior View.— The supraoccipital is flatter and directed more strongly forward than in either *M. bidens* or *M. europæus.* Superiorly it is concave in the median line, and lies considerably below the level of the edges of the frontals. The foramen magnum is widely elliptical, and slightly uneven along the superior margin. Vertically, its greatest diameter is 50 mm.; in lateral diameter it measures 55 mm. The occipital condyles are 75 mm. in greatest length, and 40 mm. wide.

Lateral View.— The massive rostrum of our specimen is shorter proportionately, more compressed laterally, and is thicker in the vertical diameter than in either *M. bidens* or *M. europæus.* It is deepest slightly in advance of the anterior insertion of the pterygoids; at this point it is 95 mm. thick. Its superior surface in the middle third is concave, and the distal portion is depressed. The basirostral groove is absent; in its place a sharp ridge extends on either side from the pseudo-maxillary notch forward on the lateral surface of the rostrum for one quarter of its length. Anterior to this ridge a shallow, irregular groove runs toward the distal end, uniting at the extreme tip of the rostrum with a short, deep, alveolus-like pit or depression. The malar shows only a small portion of its expanded, anterior end in the bottom of the real antorbital notch.

The temporal fossæ of our specimen are roughly pear-shaped and extended postero-superiorly. In *M. bidens* and *M. europæus* these fossæ lie nearly opposite the occipital condyles; in our specimen they are above them.

Inferior View.— A strong median ridge, probably the vomer, appears on the inferior surface of the proximal third of the rostrum. On either side of this ridge is a deep groove, 60 mm. in length, which gradually disappears. The palatal bones show on the inner or inferior side of the pterygoids as narrow strips, reaching almost to the tips of the latter. On the external or superior surface, the palatines appear again and are much wider than below. Here they do not extend as far forward as on the inferior surface, leaving the pointed anterior ends of the pterygoids, superiorly, for a distance of 45 mm., in contact with the maxillaries. In *M. bidens* the palatines completely surround the pterygoids, and in *M. europæus* nearly so. The pterygoids of our specimen are badly broken and the inferior free portion of the left has been restored. However, in the right the original shape of the bone is preserved. Its exterior surface is deeply concave and the free lateral margin curves outward posteriorly.

The zygomatic processes of the squamosals extend far forward and are overlapped by the postorbital processes of the frontals.

Ear Bones.— A comparison of the ear bones of our specimen with those of a young example of *M. grayi* shows a very close resemblance. The groove between the posterior lobes of the tympanic, however, is somewhat deeper and shorter than in the latter individual. The inner surface of the tympanic, where it passes into the bulla, is decidedly narrower in our specimen, than in the corresponding bone of *M. bidens*, as figured by Van Beneden and Gervais; also the bullate portion of the periotic seems to be larger than in *M. bidens.*

Mandible.— The mandible of our specimen is more massive throughout, in proportion to the skull, than in either *M. bidens* or *M. europæus*. Externally the proximal half of each ramus is smooth and convex. The superior margin curves upward and outward to form the walls of an irregular alveolus in which the base of the tooth is firmly implanted. The internal alveolar wall rises in a strong convex process half way up the sides of the tooth; externally this process is wanting and the margin is irregularly concave. The ramus is *not* swollen at the insertion of the tooth. The tooth itself is situated one third the distance from the apex of the mandible to the condyles; its anterior margin is 15 mm. *posterior* to the beginning of the symphysis, and is directed outward. The tooth is laterally compressed, convex posteriorly, and slightly concave anteriorly; its surface is rugose. Its greatest height is 90 mm. and greatest width 75 mm. The small enamel-covered tip appears as if emerging from out the wide, flat base and is directed forward and outward. The apex of the right tooth is considerably worn. A shallow but clearly defined dental groove extends from the anterior base of the tooth nearly to the end of the symphysis; behind the tooth it is indistinct. For a distance of 40 mm. from the tooth the external alveolar margin projects above the internal edge. The symphysis curves slightly upward, is grooved superiorly in the median line and carinate inferiorly; above, the rami are ankylosed for 145 mm.; below for 93 mm. The symphysis is a little less than one quarter the length of the mandible.

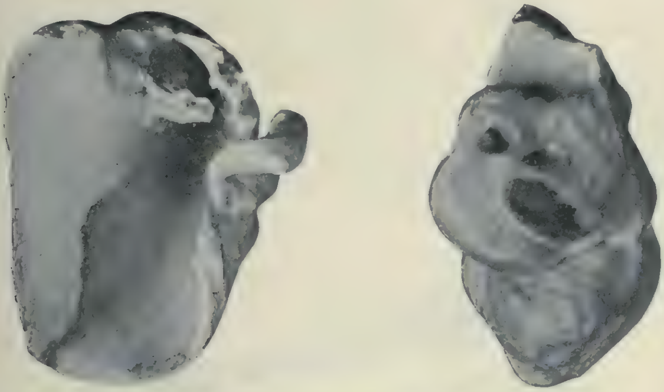


Fig. 1. *Mesoplodon bowdoini.* Tympanic and periotic bones.

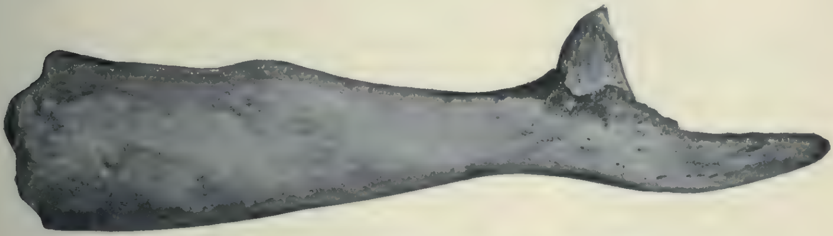


Fig. 2. *Mesoplodon bowdoini.* Side view right ramus.

Hyoid Bones.— The basihyal and two thyrohyals are united into one bone. The thyrohyals measure 130 mm. in length and 50 mm. in greatest breadth. They are curved, their free ends standing 183 mm. apart. The basihyal is 80 mm. in greatest diameter; the anterior edge is formed by two processes or tubercles having a notch 5 mm. in depth between them. The stylohyals are 170 mm. in length and 33 mm. in greatest diameter. They have a distinct head, are flattened for half their extent, and then become prismoid.

Vertebræ.— In the following description of the skeleton of our *Mesoplodon*, the most salient differences between it and various examples of *M. bidens* will be briefly stated.

The length of the entire skeleton of our specimen as mounted is 166¼ inches or 4222 mm.; *M. bidens* (adult) 4350 mm.[1] The length of the vertebral column is 138 inches or 3505 mm.; in two adult examples of *M. bidens* it measures 3580 mm.[1] and 3657[2] (estimated). The vertebral formula of our specimen is C. 7, D. 10, L. 9, Ca. 20[3]=46. Turner gives the formulæ of various specimens of *M. bidens* as follows:[2] C. 7, D. 10, L. 11, Ca. 11,[4] Shetland specimen. C. 7, D. 10, L. 10, Ca. 19, Brussels specimen. C. 7, D. 10, L. 9, Ca. 20, Göteborg specimen.

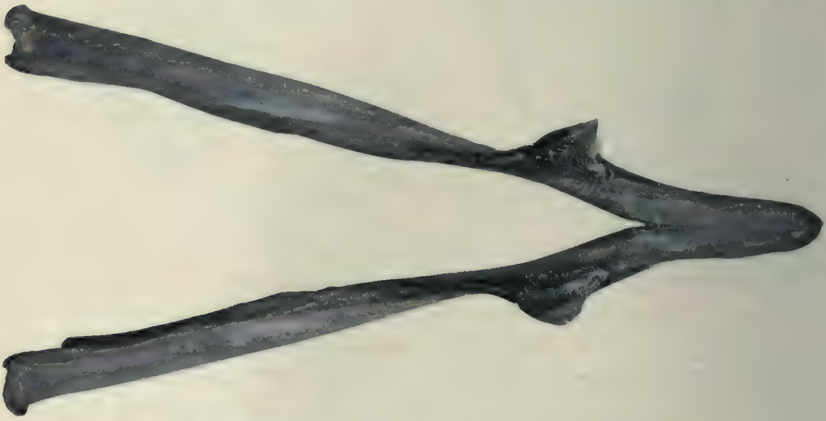


Fig. 3. ***Mesoplodon bowdoini.*** **Top view of mandible.**

Cervicals.— The atlas, axis and 3d cervical are ankylosed; the atlas and axis by both their centra and neural arches, forming a solid bone; the third vertebra by its centrum alone, the arch being free. The atlas has no diapophyses. The inferior transverse processes (parapophyses) are massive (the largest of the series) and extend downward and backward. On the crest of the atlas and axis two short conical spines project directly upward;

---

[1] M. P. Fischer, Compt. Rend. Acad. Sci. Paris, Vol. CXIV, p. 1284.
[2] Turner Jour. Anat. and Phys., Vol. XVI, p. 466.
[3] Terminal caudal probably missing.
[4] Incomplete.

they are parallel, 13 mm. in height, their apices standing 25 mm. apart. The diapophyses of the axis are short, thick, and extend outward and downward distally. Its parapophyses are long and united at the distal ends with those of the atlas, enclosing an elliptical foramen on either side. In *M. bidens* no foramen is enclosed. The diapophyses of the 3d, 4th, 5th and 6th cervicals are thin plates. Those of the 3d extend slightly backward, of the 4th outward, and of the 5th and 6th forward. From the 3d to the 6th they become shorter and rise in position on the arch. Their parapophyses all project downward and become shorter and thicker in passing backward. The laminæ of the arches of these vertebræ are slender, *united mesially*, and directed forward; they have no distinct spines. In *M. bidens* (excepting where the 3d is ankylosed), the laminæ of the arches of the 3d, 4th and 5th cervicals seem never to be united in the median line. The diapophyses of the 7th vertebra are the longest of the series and project strongly forward. Its parapophyses are merely tubercles above which, on the centrum of the vertebra, are the articular facets for the heads of the 1st ribs. The neural spine is 25 mm. high and leans forward.

In the Shetland *M. bidens* (Turner) the antero-posterior diameter of the series of cervical vertebræ was 139 mm.; the greatest height of the atlas was 127 mm. and its greatest breadth 139 mm.

Dimensions of Cervical Vertebræ.

	mm.
Antero-posterior length of bodies of 7 cervicals (inferiorly) as mounted . . .	145
Antero-posterior length of centra of ankylosed 1st, 2d and 3d vertebræ (inferiorly)	58

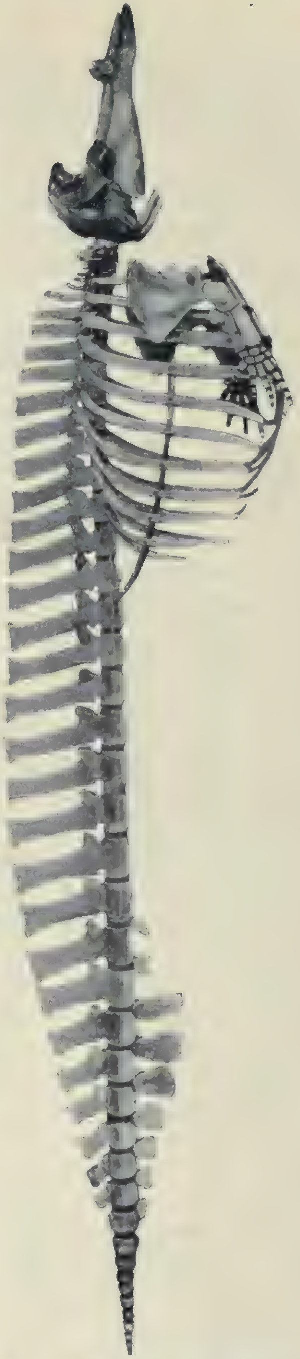


Fig. 4. *Mesoplodon bowdoini* Skeleton.

	mm.
Height of atlas from tip of spine to lower edge of body	133
Greatest breadth of atlas (between ends of parapophyses)	200
Depth of neural canal of atlas	60
Breadth " " " " "	57
Breadth between outer border of articular surfaces for occipital condyles	115
Height of 6th cervical (spine to lower edge of body)	122
Breadth of 6th cervical (between ends of diapophyses)	93
" " centrum of 6th cervical	56
Depth of 6th cervical	53
Height of 7th cervical (spine to lower edge of body)	143
Breadth of 7th cervical (between ends of diapophyses)	124
" " centrum of 7th cervical	58
Depth of 7th cervical	52

Dorsal Vertebræ.— The ten dorsal vertebræ do not present important differences from those of other Ziphoids. Their centra are concave above and elongated in the antero-posterior direction as the lumbar region is approached. Zygapophyses are developed on the arches from the 6th to the 14th vertebræ inclusive. The neural spine of the first dorsal is acuminate and inclined forward. The spines of the 2d, 3d, 4th and 5th dorsals are *vertical* and obliquely truncated distally, excepting that of the 3d which is rounded. The spines of the remaining units of the thoracic series are inclined backward, truncated at their apices, and become broader as the lumbar region is approached. The first seven dorsals bear tubercles on the posterior edges of their centra at the base of the arches for the articulation of the heads of the ribs. Metapophyses appear as well developed tubercles on the transverse processes of the 2d dorsal and gradually increase in size in passing backward. On the 8th unit of the dorsal series, which is the vertebra of transition, the metapophyses are large and widely separated from the transverse processes; the latter appear only as small tubercles on the anterior margins of the centrum at the base of the arch; the 8th dorsal bears no rib. In the 9th dorsal the transverse processes are 65 mm. long and deeply concave distally.

The centra of the first eight vertebræ of the series have rounded inferior surfaces. An inferior median carina begins on the 9th and is strongly developed on the 10th dorsal.

Dimensions of Dorsal Vertebræ.	1st mm.	10th mm.
Greatest height (spine to edge of body)	214	315
" breadth (between ends of diapophyses)	140	260
Height of neural spine	90	202
Depth of centrum	51	54
Breadth of centrum	54	70
Antero-posterior length of centrum	30	87

Lumbar Vertebræ.— There are nine lumbar units. Their bodies are elongated antero-posteriorly and increase in vertical diameter as the caudals are approached. They all possess a strong inferior median carina which gradually decreases in size in passing backward. Their centra, below the transverse process on either side of the median keel, are compressed. The neural spines of the lumbars are high and broad, much compressed laterally, and slope backward; they are truncated and expanded at their distal ends. The spine of the 8th lumbar measures 245 mm. and is the highest in the vertebral column. Their broad lamelliform metapophyses project forward and upward from the anterior edges of the arches, and remain at about the same height throughout the series. The transverse processes extend from the anterior half of the bodies outward and somewhat forward; distally they are truncated. Their length exceeds the width of the centra in all the lumbar units.

Measurements of Lumbar Vertebræ.

	First mm.	Last mm.
Greatest height (spine to edge of body)	**340**	**377**
" breadth (between ends of dia.)	**320**	**260**
Depth of centrum	**58**	**71**
Breadth of "	**73**	**83**
Length of centrum (antero-posterior)	**90**	**123**
Height of neural spine	**205**	**253**

Caudals.— There are 20 caudal vertebræ. The first eleven have articular surfaces for the attachment of chevrons and laterally compressed centra. The twelfth is the vertebra of transition. The second series of depressed caudals (those lying within the lateral expansion of the "flukes") begins with the 13th vertebra. The neural spines are broad, inclined backward and thicken laterally as they decrease in height. Their metapophyses become correspondingly smaller, appearing as tubercles only upon the spine of the 9th caudal. The transverse processes extend directly outward from the bodies of the vertebræ, and are broad in the beginning of the caudal region; in passing backward they become smaller. The posterior margins of the transverse processes of the 4th and 5th caudals are grooved; all the succeeding vertebræ have their transverse processes or the sides of their centra pierced by a vertical foramen. Beginning on the 4th caudal on either side, two longitudinal ridges appear; one on the centrum above the transverse processes, and the other on the lateral surface of the arch forming the posterior extension, superiorly, of the metapophysis. As the spines shorten in passing backward, these ridges approach each other forming a lateral groove or canal.

On the first caudal the inferior median carina is divided posteriorly to form articular facets for the attachment of the first chevron. All the remaining chevron-bearing caudals are channelled longitudinally below. The first caudal vertebra of the Shetland *M. bidens* (Turner) was 355 mm. in greatest height and 254 mm. in greatest width.

The following table shows a very considerable difference between our specimen and two examples of *M. bidens* in the points at which the spines and transverse processes disappear in the caudal vertebræ.

	M. bowdoini.	Turner. *M. bidens.*	Fischer. *M. bidens.*
Last vertebra bearing a neural spine is	No. 36	39	38
" " " " transverse process is . .	No. 33	37	34
First vertebra with transverse process perforated by a vertical arterial foramen is	No. 32[1]	—	—

Dimensions of First Caudal Vertebra.

	mm.
Greatest height (spine to edge of body)	366
" breadth (between ends of diapophyses)	257
Depth of centrum	76
Breadth of centrum	85
Length of centrum (antero-posterior)	124
Height of neural spine	230
Length transverse processes	80

Chevrons.— There are 9 chevrons present — probably the series originally numbered 11. The 1st chevron is small, and consists of a pair of wing-like laminæ, acuminate and free distally. The laminæ forming the 2d chevron are united at their truncated distal ends, but have no hæmal spine. The spine of the 3d chevron is long.

Measurements.

	1st mm.	2d mm.	3d mm.	4th mm.	5th mm.
Greatest length of chevron	65	60	160	162	133
" width of chevron	40	70	82	109	100
Length of hæmal spine	—	—	115	100	72
Width " " " distally	—	—	70	97	98

Ribs.— There are 10 ribs present. The 1st to the 7th inclusive articulate both by the tubercle and head, and the 8th by its head alone to the facet on the posterior margin of the centrum of the 7th dorsal. Therefore the 8th dorsal bears no rib. The 9th and 10th ribs articulate by their tubercles to the transverse processes of their respective vertebræ; they have no necks or heads.

---

[1] Right side only.

The first rib possesses well defined articular surfaces, is compressed laterally and is the broadest of the series. The proximal half is strongly curved, and from the tubercle for one third the length of the rib, its posterior, or superior, margin is everted.

The following six ribs are compressed at the necks and below the tubercles on the inner sides, then for one fourth their length assume a prismoid shape; afterward they become nearly flat with but a slight median ridge on the inner side. In passing backward the prismoid portion of the ribs becomes longer and the distal ends contract.

Greatest Length of each Rib (straight).

	mm.
First	283
Second	415
Third	510
Fourth	550
Fifth	564
Sixth	575
Seventh	560
Eighth	540
Ninth	505
Tenth	335[1]

STERNUM.— The sternum consists of four segments connected by cartilage. In the middle of both the anterior and posterior margins of each segment is a deep notch, which in the complete sternum forms three irregular fenestra.

The terminal segment, or xiphisternum, has an oval foramen in its center, and seems to be composed of two ankylosed portions. A distinct median carina is present on the external, or inferior, surface of each segment, most strongly developed in the first of the series. There are five surfaces on each side of the sternum for the costal articulations. The first is on the side of the 1st segment; the second between the 1st and 2d segments; the third between the 2d and 3d; the fourth between the 3d and 4th and the fifth on the side of the terminal segment.

Measurements of Sternum.

				mm.
Greatest length of complete sternum				545
	1st mm.	2d mm.	3d mm.	4th mm.
Greatest length of segments	208	115	97	140
" breadth of segments	188	140	115	85
Depth of anterior median notch	33			

---

[1] Distal end has been restored.

Pectoral Limb.— The scapula is fan-shaped. The prescapular fossa is concave, and the spine well marked. The acromion is broad, laterally compressed, concave on its inner side and projects *strongly upward*; its superior margin overlaps the coracoid border and is opposite the middle of the prescapular fossa. In this respect the scapula of our specimen differs from that of any other member of the genus which I have seen figured. The coracoid is long, slender, and expanded distally where it assumes a prismoid form. The humerus is short and thick. Its proximal or upper extremity is divided into a head and external tuberosity, separated by a well marked bicipital groove; the distal extremity articulates with the radius and ulna by two transverse surfaces. The radius is straight, slightly convex externally and somewhat widened at its distal end; proximally it is obliquely truncated. The shaft of the ulna is slightly contracted in its middle; a cross section is an ellipse. The olecranon process is large, thick and fan-shaped. The carpus, as mounted, presents six ossifications. Those of the proximal row probably correspond to the scaphoid, lunar and cuneiform; the three of the distal row representing the trapezoid, magnum and unciform.

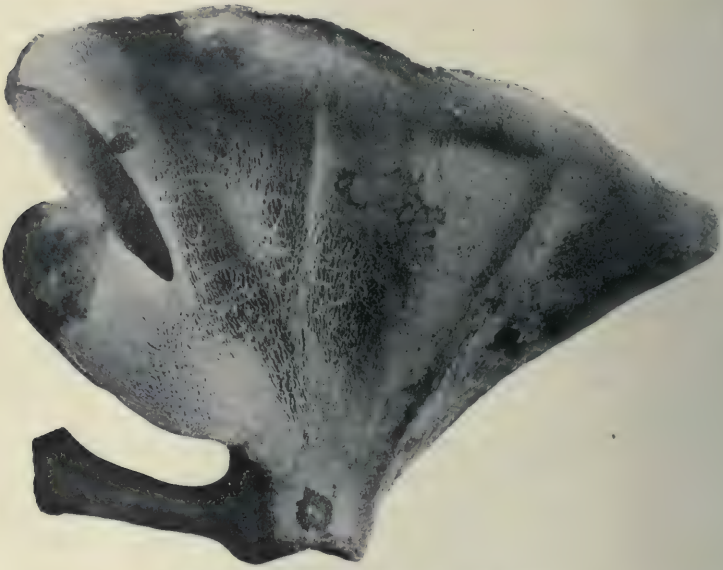
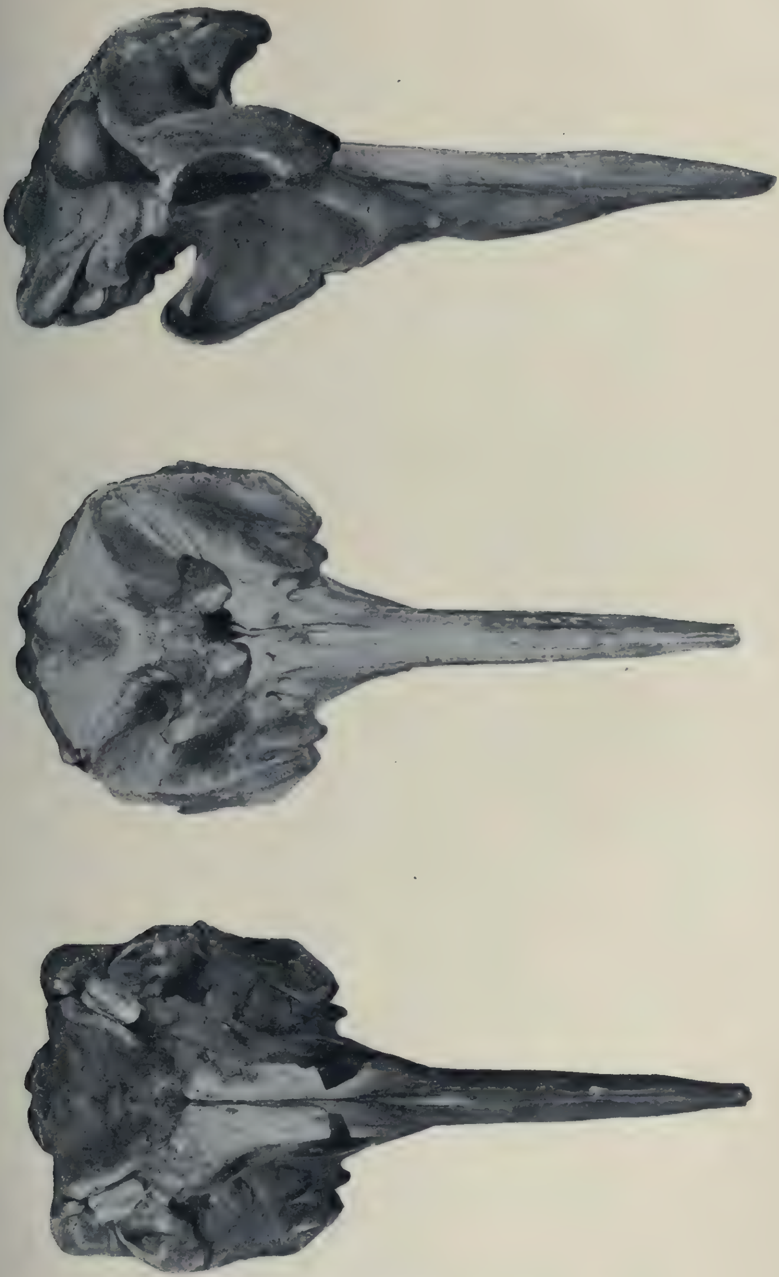


Fig. 5. *Mesoplodon bowdoini.* Left scapula.

The metacarpals are five in number. The formula for the phalanges, as mounted, is: I_0, II_4, III_3, IV_3, V_2.



MESOPLODON BOWDOINI sp. nov.

Measurements of Pectoral Limb.

	M. bowdoini. mm.	*M. bidens.*[1] mm.
Height of scapula	210	203
Breadth " "	320	311
Length " acromion (median line)	110	101
Breadth " "	55	48
Length " coracoid	91	88
Breadth " glenoid fossa	60	—
Length " humerus (greatest)	123	145
Breadth " " "	73	—
Length " radius (median)	139	—
Breadth " " proximally	44	—
" " " distally	55	—
Length " ulna (median)	130	—
Breadth " " distally	40	—
Length " olecranon process	33	—

Conclusions.— From the preceding description it is obvious that many important differences exist between the specimen here described and *M. bidens*, its nearest ally. It would, perhaps, be possible to account for many of the cranial differences on the grounds of an excessive development in the bones, produced by age, but such a theory could hardly apply to the scapular modifications. Moreover, under such conditions one would expect to find a corresponding increase in size, yet our specimen does not equal the *average* length of *M. bidens*, which is about fifteen feet. Nevertheless, the range of individual variation known to exist in all of the members of this genus is so great that any determination made between closely allied species, without a considerable amount of material for comparison, must be more or less provisional. Yet, it seems improbable to me that the cranial and skeletal differences which this specimen presents, can come within the scope of age or sexual variations. Therefore, I propose to designate it as *Mesoplodon bowdoini* in honor of Mr. George S. Bowdoin, one of the Trustees of the American Museum of Natural History, through whose generosity the enlargement of the collection of Cetaceans in this Museum has been made possible.

In conclusion, I wish to acknowledge my indebtedness to Dr. F. W. True, for the use of notes and measurements, made upon the specimen.

---

[1] Turner, Shetland specimen.

59.9, 53P(26.5)

Article XIV.— NOTES ON TWO PORPOISES CAPTURED ON A VOYAGE INTO THE PACIFIC OCEAN.

BY JOHN TREADWELL NICHOLS.

PLATE XIV.

The following notes concern two porpoises captured in the Pacific Ocean from a sailing vessel bound out around Cape Horn. Porpoises not infrequently play about the ship's bow, and sometimes one can be harpooned and secured. Their flesh tastes somewhat like meat, somewhat like fish, and is a very welcome break in a diet composed chiefly of salted and canned foods.

The skull of one and the skeleton of the other of the two specimens were preserved by the writer and are now in the American Museum of Natural History.

Tursiops sp.

No. 35045, Am. Mus. Nat. Hist. Approximate locality, 12° N., 120° W. Captured December 6, 1906.

Dimensions of skull:— Length 487 mm.; rostrum, 263 mm.; breadth of rostrum at its base, 120.5 mm.; breadth of rostrum at its middle, 74 mm.; orbital breadth, 214 mm.

Color slaty black, grayer from throat to vent. Approximate length, 7¼ feet.

The stomach contained mostly large shrimp-like animals; also a few fish, and perhaps other food matter, and many parasitic worms. The posterior teeth are much worn down, with hollow or soft centers.

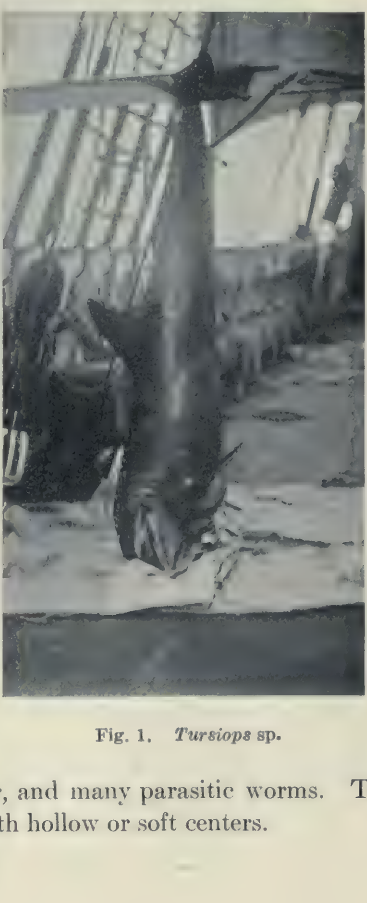


Fig. 1. *Tursiops* sp.

This animal is quite different from *Tursiops gillii*, and probably different from *T. truncatus* of our Atlantic Coast, though the material is not sufficient to warrant separating it positively from that species.

The skull differs in several points from that of *T. truncatus*. The intermaxillæ are rather flat distally. The maxilla, just back of the maxillary notch, is much less thickened. The malar along its outer margin is longer, and directed less downward.

On the under side of the back of the cranium at the posterior border of the inferior nares, the vomer is visible between the backward prongs of the two pterygoids. At this point its sides are flaring, and it is much broader than either pterygoid alone. There is considerable variation in the series of *truncatus* skulls examined as to the comparative breadth of vomer, but it is generally narrower than in No. 35045, even to less than half the breadth of a single pterygoid; and its sides are not flaring, *i. e.*, they have a more parallel tendency.

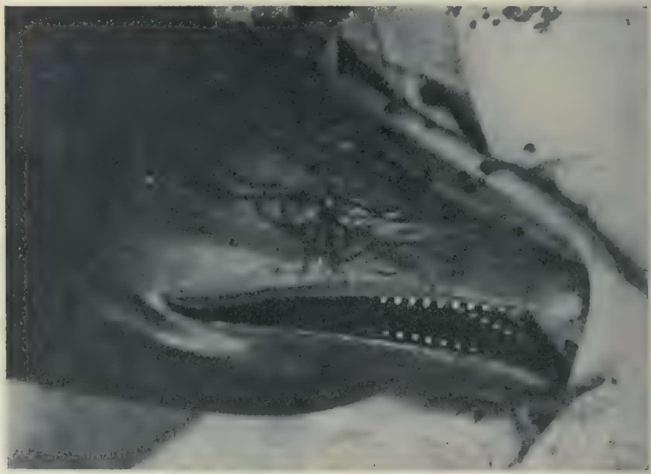


Fig. 2. *Tursiops* sp.

The comparative characters given in the two preceding paragraphs would be quite sufficient to separate No. 35045, were they not broken by two or three skulls.

There is a *truncatus* skull [1] in the National Museum Collection from off Hatteras, N. C., which has the conditions back of the maxillary notch perhaps more like those of No. 35045 than like those found typically in *truncatus*.

In the 'Ostéographie des Cétacés,' Van Beneden and Gervais, there is a figure[1] of a skull of *T. truncatus* from Cette, France, which shows plainly the vomer-pterygoid conditions, and they are very like those of No. 35045.

---

[1] Nat. Mus. No. 21538. Off Hatteras, N. C. U. S. F. C.

Lagenorhynchus cruciger (*d'Orb. & Gerv.*).

No. 35150 Am. Mus. Nat. Hist. (?♂).
Approximate locality, 49° S., 78° W. Taken November 1, 1906.
Approximate length, 5⅓ ft.

The stomach contained a mass of more or less digested small fish, which may have been mixed with other food matter.

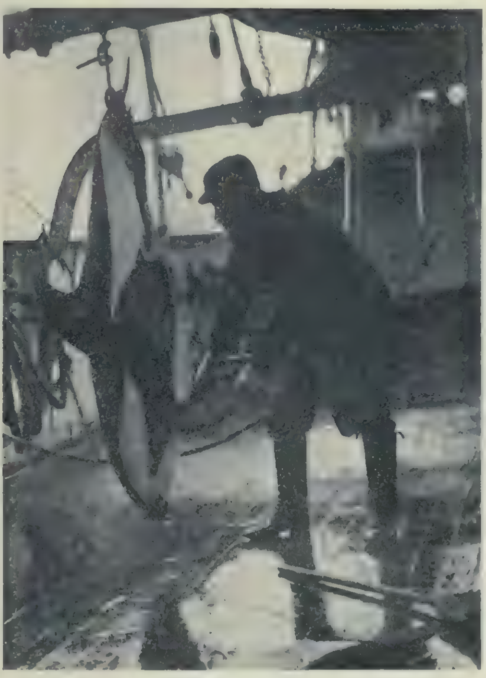


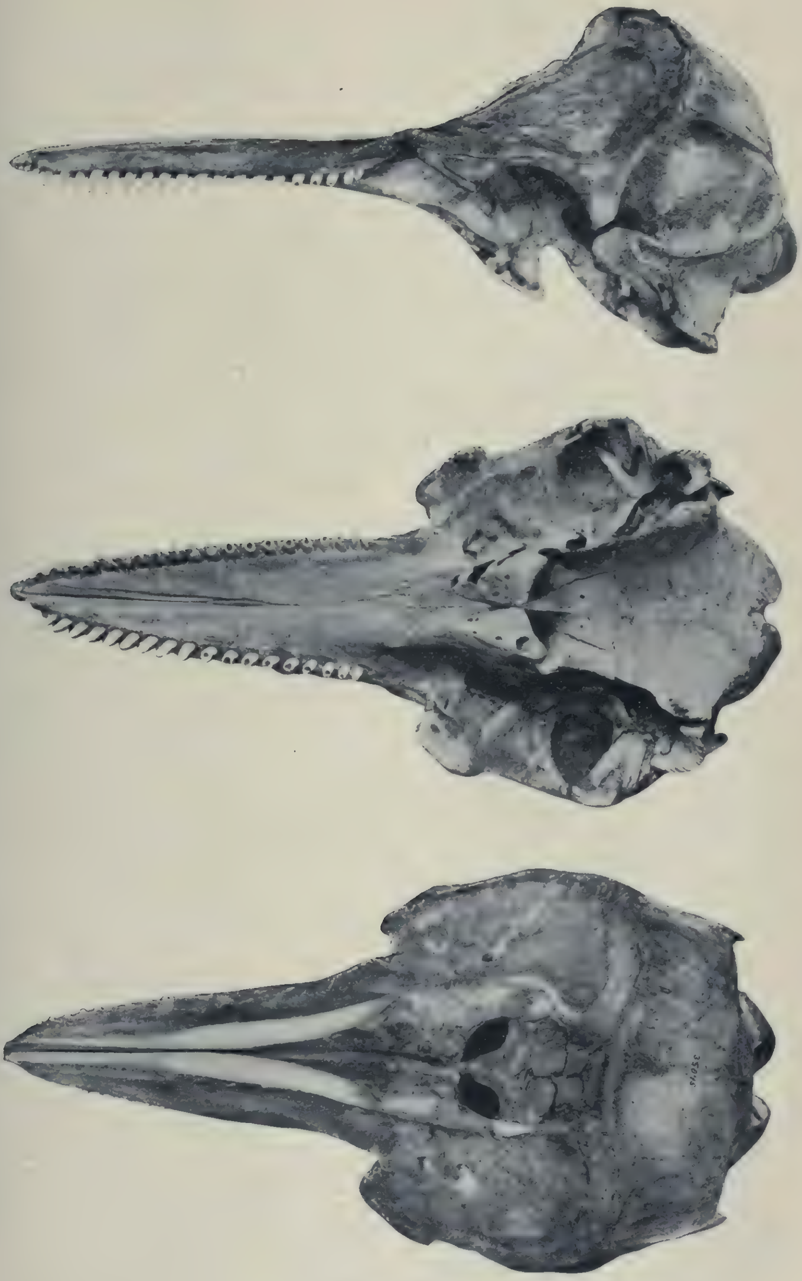
Fig. 3. *Lagenorhynchus cruciger* (d'Orb. & Gerv.).

Porpoises that I believe to have been of this species were seen in approximate localities of 36° 14′ S., 52° 43′ W. (Sept. 29), 47° 08′ S., 59° 34′ W. (Oct. 15), 52° 46′ S., 66° 00′ W. (Oct. 19), 53° 48′ S., 78° 42′ W. (Oct. 29).

I wish to express my indebtedness to Dr. Frederick W. True of the U. S. National Museum for greatly aiding me in the study of these specimens, placing at my disposal the material of the National Museum and the necessary literature.

---

[1] Van Beneden and Gervais, 1868–1879, Ostéographie des Cétacés, pl. XXXIV, fig. 6.



Tursiops sp.

56.9, 725E(1181:7)

Article XV.— A REVISION OF THE AMERICAN EOCENE HORSES.

By Walter Granger.

Plates XV–XVIII.

This paper forms one of a series of several, published in this Bulletin, on the various groups of the American Equidæ and is intended, with the others, as a study preliminary to a forthcoming monographic treatise of the Equidæ by Prof. Henry F. Osborn, to whom I am indebted for the privilege of publishing this revision, as well as for much valuable criticism and aid in its preparation. The pencil drawings, by Mr. B. Yoshihara, of the unfigured types of Eocene Horses have been prepared under Prof. Osborn's direction for use in his Monograph but he has very generously offered them for preliminary reproduction here. I wish also to make acknowledgment to Dr. W. D. Matthew for free use of his notes on American Hyracotheres.

In the preparation of this paper I have had access to all of the types, with one exception, of the American Hyracotheres. These include Marsh's types in the Yale Museum and Cope's New Mexican Wasatch types in the National Museum. Leidy's type of *Lophiotherium sylvaticum* is represented in the collection of the Museum by a cast. All of the remaining types are in the American Museum Collection. Through the courtesy of Dr. F. B. Loomis of Amherst College I have also had for comparison the more important specimens of a rather extensive collection of horses made by him in the Big Horn and Wind River Basin in 1903. The American Museum Collection contains several hundred specimens of Hyracotheres, representing nearly all of the described species. About half of these are from the Cope Collection and the remainder have been collected by the various expeditions sent out by this Museum since 1891.

Distribution.— Hyracotheres have been recorded from the Wasatch of Evanston, Bitter Creek, and the Big Horn Basin in Wyoming, and of the Rio Gallinas in Northern New Mexico; from the Wind River Basin of central Wyoming; from the Huerfano Basin of southeastern Colorado; from the Bridger Basin of southern Wyoming; and from the Uinta Basin of northeastern Utah. So far as I am aware, no horses have yet been found in the Washakie Basin of southern Wyoming. That they occur there and will be found in future exploration seems probable, however, since they are fairly abundant in the Bridger and by no means rare in the Uinta.

The horizon of their greatest abundance is the Wasatch, especially the Wasatch of the Big Horn Basin, where they predominate over all other forms, with the possible exception of *Systemodon*, a very closely related genus. In the Wind River formation they also form a large part of the fauna. In the Bridger, however, they are exceeded in abundance by several families, and the same is true in a more marked degree in the Uinta.

A. List of Original Specific and Generic Descriptions in Chronological Order with Chief Subsequent References to the Species.

WASATCH AND WIND RIVER SPECIES.

1. **Lophiotherium vasacciense** *Cope.*

Proc. Amer. Phil. Soc. XII. Separates, July 11, 1872, p. 2.
Notharctus vasachiensis COPE, Palæont. Bull., No. 3, 1872, p. 3.
Notharctus vasacciensis COPE, Proc. Amer. Phil. Soc., XII, 1872, p. 474.
Orotherium vasacciense COPE, Ann. Rep. U. S. G. S. Terrs., 1872 (1873), pp. 606, 646.
Orohippus vasacciensis COPE, System. Cat. Vert. Eocene N. Mex., 1875, p. 21.
Hyracotherium vasacciense COPE, Tertiary Vert., 1884, p. 634, pl. xxiv, fig. 24.
Hyracotherium vasacciense WORTMAN, Bull. A. M. N. H., VIII, 1896, p. 98.
Hyracotherium vasacciense MATTHEW, Bull. A. M. N. H., XII, 1899, p. 33.
Eohippus vasacciensis HAY, Bull. U. S. G. S., No. 179, 1902, p. 610.

Type locality: Evanston, Wyo. *Type Specimen:* A weathered lower molar, probably the second. Amer. Mus., Cope Coll. No. 4658.

An indeterminate type; see *Eohippus borealis*.

2. **Orotherium index** *Cope.*

Pal. Bull. No. 17, 1873, p. 4.
Orohippus index COPE, System. Cat. Vert. Eocene N. Mex., 1875, p. 20.
Hyracotherium index COPE, Tertiary Vert., 1884, pp. 630, 650.
Hyracotherium index WORT., Bull. A. M. N. H., VIII, 1896, p. 99.
Hyracotherium index MATT., Bull. A. M. N. H., XII, 1899, p. 33.
Eohippus index HAY, Bull. U. S. G. S., No. 179, 1902, p. 609.

Type locality: Evanston, Wyo. *Type specimen:* lower jaw fragment with p_4–m_3. Amer. Mus., Cope. Coll. No. 4680.

= *Eohippus index.*

3. **Orohippus tapirinus** *Cope.*

System. Cat. Vert. Eocene N. Mex., 1875, p. 20.
Hyracotherium tapirinum COPE, U. S. Geog. Surv. w. 100th M., IV, pt. ii, 1877, p. 263, pl. xvi, fig. 12.
Systemodon tapirinus COPE, Am. Nat., XV, 1881, p. 1018.
Systemodon tapirinus COPE, Tertiary Vert., 1884, p. 619.
Hyracotherium tapirinum WORT., Bull. A. M. N. H., VIII, 1896, p. 94.
Hyracotherium tapirinum MATT., Bull. A. M. N. H., XII, 1899, p. 33.
Eohippus tapirinus HAY, Bull. U. S. G. S., No. 179, 1902, p. 610.

Type locality: Rio Gallinas, Wasatch of New Mexico. *Type specimen:* fragment of ramus with badly worn m_{2-3}. Nat. Mus. Coll. No. 1064.

This type is at least specifically indeterminate. See *Eohippus resartus.*

4. **Orohippus angustidens** *Cope.*

System. Cat. Vert. Eocene N. Mex., 1875, pp. 20, 21.
Hyracotherium angustidens COPE, U. S. Geog. Surv. w. 100th M., IV, pt. ii, 1877, pp. 262, 265, pl. lxvi, fig. 22a.
Eohippus angustidens KING (= Marsh), U. S. Geol. Expl. 40th P., 1878, p. 377.
Hyracotherium angustidens COPE, Tertiary Vert., 1884, p. 630, 648.
Hyracotherium index WORT., Bull. A. M. N. H., VIII. 1896, p. 99.
Hyracotherium index MATT., Bull. A. M. N. H., XII, 1899, p. 33.
Eohippus index HAY, Bull. U. S. G. S., No. 179, 1902, p. 609.

Type locality: Rio Gallinas, Wasatch of New Mexico. *Type specimen:* A lower jaw fragment with m_{1-3}. Nat. Mus. Coll. No. 1079.

= *Eohippus angustidens.*

5. **Orohippus cuspidatus** *Cope.*

System. Cat. Ext. Vert. N. Mex., 1875, p. 22.
Hyracotherium cuspidatum COPE, U. S. Geog. Surv. w. 100th M., IV, pt. ii, 1877, p. 267, pl. lxv, fig. 18.
Eohippus cuspidatus KING (=Marsh), U. S. Geol. Expl. 40th P., I, 1878, p. 377.
Hyracotherium cuspidatum COPE, Tertiary Vert., 1884, p. 631.
Hyracotherium index WORT., Bull. A. M. N. H., VIII, 1896, p. 99.
Hyracotherium index MATT., Bull. A. M. N. H., XII, 1899, p. 33.
Eohippus index HAY, Bull. U. S. G. S., No. 179, 1902, p. 609.

Type locality: Rio Gallinas, Wasatch of New Mexico. *Type specimen:* Maxillary fragment with dp^4 and m^1. Nat. Mus. Coll. No. 1077.

= *Eohippus (?) angustidens.*

6. **Eohippus validus** *Marsh.*

Am. Jour. Sci., XII, 1876, p. 401.
Hyracotherium vasacciense Wort., Bull. A. M. N. H., VIII, 1896, p. 82.
Hyracotherium vasacciense Matt., Bull. A. M. N. H., XII, 1899, p. 33.
Eohippus validus Hay, Bull. U. S. G. S., No. 179, 1902, p. 610.

Type locality: Rio Gallinas, Wasatch of New Mexico. *Type specimen:* Fragments of jaws with p_4–m_3 r., p_4–m_1 and m_3 l., p^4–m^1 r., an m^2 l. of doubtful association and many uncharacteristic fragments of skeleton. Yale Mus. Coll.

Generic type for all American *Hyracotheres* earlier than the Bridger formation.

= *Eohippus validus.*

7. **Eohippus pernix** *Marsh.*

Am. Jour. Sci., XII, 1876, p. 402.
Eohippus pernix Marsh, Am. Jour. Sci., XLIII, 1892, p. 349, text figs. 14, 15.
Hyracotherium index Wort., Bull. A. M. N. H., VIII, 1896, p. 82.
Hyracotherium index Matt., Bull. A. M. N. H., XII, 1899, p. 33.
Eohippus pernix Hay, Bull. U. S. G. S., No. 179, 1902, p. 609.

Type locality: Bitter Creek, Wyo. *Type specimen:*[1] Various skeletal fragments and teeth belonging to several individuals and to at least two species; from these may be selected, as the actual type, being the parts first separately mentioned, the distal end of a tibia and the accompanying astragalus. Yale Mus.

An indeterminate species; = *Eohippus index* (?).

8. **Orotherium cristonense** *Cope.*

U. S. Geog. Surv. w. 100th M., IV, pt. ii, 1877, p. 254, pl. lxv, fig. 13, 14.
Pliolophus cristonensis Cope, Tertiary Vert., 1884, p. 651.
Hyracotherium (*Pliolophus*) *cristonense* Wort., Bull. A. M. N. H., VIII, 1896, p. 102, pl. ii, fig. I, text fig. 11.
H. (*Pliolophus*) *cristonense* Matt., Bull. A. M. N. H., XII, 1899, p. 33.
Pliolophus cristonensis Hay, Bull. U. S. G. S., No. 179, 1902, p. 610.

Type locality: Rio Gallinas, Wasatch of New Mex. *Type specimen:* Lower jaws. Nat. Mus. Coll. No. 1002.

= *Eohippus cristonensis.*

---

[1] Included in the various fragments associated with the type is the proximal half of a mt. II showing the articulation for the entocuneiform. This Marsh apparently mistook for the mt. IV of the opposite foot and considered the facet as indicating a free fifth digit. There is no fourth metatarsal with this specimen and it was upon this specimen that Marsh based the determination of the foot structure of *Eohippus* given in his original description of *E. validus.*

9. **Orotherium loevii** *Cope.*

U. S. Geog. Surv. W. 100th M., IV, pt. ii, 1877, p. 257, pl. lxv, figs. 15–17.
Pliolophus loevii COPE, Tertiary Vert., 1884, p. 651.
H. (*Pliolophus*) *cristonense* WORT., Bull. A. M. N. H., VIII, 1896, p. 103.
Pliolophus cristonensis HAY, Bull. U. S. G. S., No. 179, 1902, p. 610.

Type locality: Rio Gallinas, Wasatch of New Mex. *Type specimen:* Fragment of left ramus with p_2–m_2. Nat. Mus. Coll. No. 1128.
= *Eohippus cristonensis.*

10. **Hyracotherium craspedotum** *Cope.*

Amer. Nat., XIV, 1880, p. 747.
Hyracotherium craspedotum COPE, Tertiary Vert., 1884, p. 631, pl. lviii, figs. 1, 2.
Hyracotherium craspedotum WORT., Bull. A. M. N. H., VIII, 1896, p. 97, pl. 11, fig., text fig. 7.
Hyracotherium craspedotum MATT., Bull. A. M. N. H., XII, 1899, p. 36.
Eohippus craspedotus HAY, Bull. U. S. G. S., No. 179, 1902, p. 609.

Type locality: Wind River Basin, Wyo. *Type specimen:* Fragments of both rami with m_{1-3} r., p_2 and p_4–m_1 l. Am. Mus., Cope Coll. No. 4830.
= *Eohippus craspedotus.*

11. **Hyracotherium venticolum** *Cope.*

Bull. U. S. G. S. Terrs., VI, Art. xv, 1881, p. 198.
Hyracotherium venticolum COPE, Tertiary Vert., 1884, pp. 630–635, pl. xlixa, xlixb, xlixc.
Hyracotherium venticolum WORT., Revue Sci., V, 1883, p. 709, fig. 128–130.
Hyracotherium venticolum COPE, Am. Nat., XXI, 1887, p. 995, pl. xxx, text figs. 5–7.
Protorohippus venticolus WORT., Bull. A. M. N. H., VIII, 1896, p. 105, pl. ii, fig. D., text fig. 14.
Protorohippus venticolus MATT., Bull. A. M. N. H., XII, 1899, p. 36.
Protorohippus venticolus HAY, Bull. U. S. G. S., No. 179, 1902, p. 610.

Type locality: Alkali Creek, Wind River Basin, Wyo. *Type specimen:* Skull, jaws, and large part of skeleton. Am. Mus., Cope. Coll. No. 4832.
= *Eohippus venticolus.*

12. **Systemodon etsagicus** *Cope.*

Tertiary Vertebrata, 1884, pl. lxi, fig. 5 (no description).

Type locality: Big Horn Basin, Wyo. *Type specimen:* Fragment of left ramus with p_4–m_2, roots or alveoli of p_{1-3}. Amer. Mus., Cope. Coll. No. 4600.

= *Eohippus etsagicus.*

13. **Hyracotherium cristatum** *Wortman.*

Bull. A. M. N. H., VIII, 1896, p. 96, pl. ii, fig. H., text fig. 6.
H. (*Pliolophus*) *cristatum* Wort., Bull. A. M. N. H., XII, 1899, p. 33.
Eohippus cristatus Hay, Bull. U. S. G. S., No. 179, 1902, p. 609.

Type locality: Big Horn Basin, Wyo. *Type specimen:* Lower jaw fragment with p_3–m_2 r. Amer. Mus. Coll. No. 258b.

= *Eohippus cristatus.*

14. **Hyracotherium (Pliolophus) montanum** *Wortman.*

Bull. A. M. N. H., VIII, 1896, p. 103, pl. ii, fig. J., text fig. 13.
H. (*Pliolophus*) *montanus* Matt., Bull. A. M. N. H., XII, 1899, p. 33.
Pliolophus montanus Hay, Bull. U. S. G. S., No. 179, 1902, p. 610.

Type locality: Big Horn Basin, Wyo. *Type specimen:* Fragments of both rami with p_4 and roots of p_{1-3} r., and m_{2-3} l. Amer. Mus., Cope. Coll. No. 4593.

= *Eohippus montanus.*

BRIDGER SPECIES.

15. **Lophiotherium sylvaticum** *Leidy.*

Proc. Acad. Nat. Sci. Phila., 1870, p. 126.
Lophiotherium sylvaticum Leidy, Rep. U. S. G. S. Terrs., I, 1873, pp. 69, 327, pl. vi, fig. 33–35.
Pliolophus sylvaticus Cope, Tertiary Vert., 1884, pp. 631, 647, 652.
Orohippus sylvaticus Matt., Bull. A. M. N. H., XII, 1899, p. 45.
Orohippus sylvaticus Hay, Bull. U. S. G. S., No. 179, 1902, p. 612.

Type locality: Henry's Fork, Upper beds, Bridger Basin. *Type specimen*: Fragment of left ramus with p_4 and m_{1-3}. Nat. Mus. Coll. No. 3753.

= *Orohippus sylvaticus.*

16. **Lophiodon pumilus** *Marsh.*

Am. Jour. Sci., II, 1871, p. 38.
Helohippus pumilus Marsh, Am. Jour. Sci., XLIII, 1892, p. 353.

Helohippus pumilus MATT., Bull. A. M. N. H., XII, 1899, p. 45.
Helohippus pumilus HAY, Bull. U. S. G. S., No. 179, 1902, p. 611.

Type locality: "Marsh's Fork," Bridger Basin. *Type specimen:* Fragment of right maxilla with p^3–m^2 and roots of p^{1-2}. Yale Mus. Coll.
= *Orohippus pumilus.*

17. **Lophiotherium ballardi** *Marsh.*

Am. Jour. Sci., II, 1871, p. 39.
Orohippus sylvaticus MATT., Bull. A. M. N. H., XII, 1899, p. 45.
Orohippus ballardi HAY, Bull. U. S. G. S., No. 179, 1902, p. 611.

Type locality: Grizzly Buttes, Hor. B., Bridger Basin. *Type specimen:* Fragment of left ramus with m_{2-3}. Yale Mus. Coll.
= *Orohippus ballardi.*

18. **Orohippus pumilus** *Marsh.*

Am. Jour. Sci., IV, 1872, p. 207. (Separates issued Aug. 7.)
Orohippus procyoninus COPE, Ann. Rep. U. S. G. S. Terrs., 1872 (1873), p. 606.
Orohippus pumilus MARSH, Am. Jour. Sci., VII, 1874, p. 249.
Orohippus pumilus MATT., Bull. A. M. N. H., XII, 1899, p. 45.
Orohippus pumilus SCOTT, OSB. and SPIER., Pal. Rep. Princ. Sci. Exp., 1871, p. 24.
Orohippus pumilus HAY, Bull. U. S. G. S., No. 179, 1902, p. 612.

Type locality: Grizzly Buttes, Lower beds, Bridger Basin. *Type specimen:* The following loose teeth: p^3 l., m^1 l., m^3 ?l. m^3 r. Paratype, m^3 r., p^4 r., p^4 r. of another specimen and a broken tooth. Yale Mus. Coll.
= *Orohippus typicus.*

19. **Helotherium procyoninum** *Cope.*

Pal. Bull. No. 2, bearing date Aug. 3, 1872, p. 1.
Helotherium procyoninum COPE, Proc. Am. Phil. Soc., XII, 1872, p. 466.
Orohippus procyoninus COPE, Ann. Rep. U. S. G. S. Terrs., 1872 (1873), p. 606.
(?)*Orohippus pumilus* MARSH, Am. Jour. Sci., VII, 1874, p. 249.
Hyracotherium procyoninum COPE, Geog. Surv. W. 100th M., IV, 1877, pp. 262, 266.
Lambdotherium procyoninum COPE, Tertiary Vert., 1884, pp. 631, 711, pl. xxiv, fig. 22.
Hyracotherium procyoninum MATT., Bull. A. M. N. H., XII, 1899, p. 45.
Orohippus procyonimus HAY, Bull. U. S. G. S., No. 179, 1902, p. 612.

Type locality: Cottonwood Creek, Horizon B, Bridger Basin. *Type specimen:* Third right upper molar. Amer. Mus., Cope. Coll. No. 5052.
= *Orohippus* (?) *pumilus.*

20. **Orotherium uintanum** *Marsh.*

Amer Jour. Sci., IV, 1872, p. 217.
Orotherium uintanum Cope, Bull. U. S. G. S., Terrs., VI, p.
Pliolophus uintanus Cope, Tertiary Vert., 1884, p. 651.
Orohippus uintanus Matt., Bull. A. M. N. H., XII, 1899, p. 45.
Orohippus uintanus Hay, Bull. U. S. G. S., No. 179, 1902, p. 612.

Type locality: Henry's Fork, Upper beds, Bridger Basin. *Type specimen:* Lower jaw with p_2–m_3. Yale Mus. Coll.

= *Orohippus uintanus.*

21. **Orohippus agilis** *Marsh.*

Amer. Jour. Sci., V, 1873, p. 407.
Orohippus agilis Marsh, Amer. Jour. Sci., VII, 1874, pp. 248, 249, text fig.
Orohippus agilis Cope, System. Cat. Vert. Eocene N. Mex., 1875, p. 22.
Hyracotherium agile Cope, U. S. Geog. Surv. w. 100th M., IV, pt. ii, p. 267.
Epihippus agilis Osborn, Trans. Amer. Phil. Soc., XVI, 1890, p. 506.
Orohippus agilis Marsh, Amer. Jour. Sci., XLIII, 1892, p. 349, text fig. 16, 17.
Orohippus agilis Matt., Bull. A. M. N. H., XII, 1899, p. 45.
Orohippus agilis Hay, Bull. U. S. G. S., No. 179, 1902, p. 611.

Type locality: Henry's Fork, Upper beds, Bridger Basin. *Type specimen*: Fragmentary skull with p_1–m_2 l., nearly complete fore limb and many vertebræ all in fine preservation. Yale Mus. Coll.

= *Orohippus agilis.*

22. **Oligotomus cinctus** *Cope.*

Pal. Bull. No. 12, March 8, 1873, p. 2.
Oligotomus cinctus Osb. Scott & Spier, Pal. Rep. Prince. Sci. Exp., 1877 (1878), p. 17.
Pliolophus cinctus Cope, Tertiary Vert., 1884, p. 653, pl. xxiv, fig. 26.
Orohippus cinctus Wort., Bull. A. M. N. H., VIII, 1896, p. 103.
Oligotomus cinctus Matt., Bull. A. M. N. H., XII, 1899, p. 45.
Orohippus cinctus Hay, Bull. U. S. G. S., No. 179, 1902, p. 611.

Type locality: Cottonwood Creek, Hor. B., Bridger Basin. *Type specimen:* Fragment of right ramus with broken p_4–m_1. Amer. Mus., Cope Coll. No. 5050.

= *Orohippus* (?) *ballardi.*

23. **Orohippus major** *Marsh.*

Am. Jour. Sci., VII, 1874, p. 248.
Pliolophus major Osborn, Trans. Amer. Phil. Soc., XVI, 1890, p. 544.

Orohippus major Matt. Bull. A. M. N. H., XII, 1899, p. 45.
Orohippus major Hay, Bull. U. S. G. S., No. 179, 1902, p. 611.

Type locality: Millersville, Horizon B., Bridger Basin. *Type specimen:* Upper jaw fragment with m_{2-3} r., and m^2 l. Yale Mus. Coll.

24. **Hyracotherium osbornianum** *Cope.*

Tertiary Vert., 1884, pp. 630, 647, pl. xxiv, fig. 23.
Hyracotherium osbornianum Matt., Bull. A. M. N. H., 1899, p. 45.
Orohippus osbornianus Hay, Bull. U. S. G. S., No. 179, 1902, p. 611.

Type locality: Black's Fork, Hor. B., Bridger Basin. *Type specimen:* Lower jaw fragment with first molar and roots of p and m_{2-3}. Amer. Mus., Cope. Coll. No. 5051.
= *Orohippus osbornianus.*

Uinta Species.

25. **Anchitherium gracilis** *Marsh.*

Amer. Jour. Sci., II, 1871, p. 38.
Orohippus gracilis Marsh, Am. Jour. Sci., VII, 1874, p. 249.
Epihippus Marsh (genus only), Popular Sci. Monthly April, 1878, footnote on p. 678.
Epihippus gracilis King (= Marsh), U. S. Geol. Expl. 40th P., 1878, p. 407.
Epihippus gracilis Scott & Osb., Proc. Am. Phil. Soc., 1887, p. 259.
Epihippus gracilis Matt., Bull. A. M. N. H., XII, 1899, p. 49.
Epihippus gracilis Hay, Bull. U. S. G. S., No. 179, 1902, p. 612.

Type locality: White River, Uinta Basin, Utah. *Type specimen:* Fragments of both rami with dp_{2-4} and m_{1-2}l., dp_{3-4} and m_1r. Yale Mus. Coll.
= *Epihippus gracilis.*

26. **Orohippus uintensis** *Marsh.*

Am. Jour. Sci., XIV, 1875, p. 247.
Epihippus Marsh (genus only), Popular Sci. Monthly, April, 1878, footnote on p. 678.
Epihippus uintensis King (= Marsh), U. S. Geol. Expl. 40th P., 1878, p. 407.
Epihippus uintensis Scott and Osb., Proc. Am. Phil. Soc., XXIV, 1887, p. 259.
Epihippus uintensis Osborn, Trans. Am. Phil. Soc., XVI, 1890, p. 529.
Epihippus uintensis Matt., Bull. A. M. N. H., XII, 1899, p. 49.
Epihippus uintensis Hay, Bull. U. S. G. S., No. 179, 1902, p. 612.

Type locality: White River, Uinta Basin, Utah. *Type specimen:* Upper and lower jaw fragments with m_{1-2}r., p_2–m_1l., m_2r. Yale Mus. Coll.

= *Epihippus gracilis.*

B. Generic References.[1]

Orohippus[2] Marsh.[3] Type *O. pumilus,* from Henry's Fork, Bridger Basin. It is unfortunate that this name, which is apparently applicable to all of the Bridger horses, should have been founded upon such a fragmentary specimen. The type description was based upon two series of loose upper teeth which represent two individuals and probably two species. The series which forms the actual type, being the first separately mentioned, has but one perfect tooth, the last molar, although a third premolar and first molar are sufficiently well preserved to give their more important characters and to make sure the reference of more complete material. The specific name *pumilus* is preoccupied by *Lophiodon pumilus* Marsh (1871), a name given to a specimen which is generically identical with the type of *Orohippus.*

Helotherium Cope.[4] The type is a single upper third molar from the Bridger Beds which is generically identical with the type of *Orohippus.* If the date, Aug. 3, printed on "Palæontological Bulletin No. 2," which contained the original description of *Helotherium procyoninum,* represents the actual date of the publication of this pamphlet then the generic name *Helotherium* would have to stand for the Bridger horses and *Orohippus,* proposed by Prof. Marsh on Aug. 7, would become a synonym. Prof. Marsh, however, questioned the correctness of the dates on the various "Bulletins" issued by Cope during the summer of 1872 and apparently not without reason. That Aug. 3 is not the correct date for "Bulletin No. 2" I am unable to prove, but the fact that there is a doubt as to its correctness and that Marsh's name *Orohippus* is the one in general use and that Prof. Cope himself referred his specimen to that genus the following year (1873) warrants, I think, the retention of the name *Orohippus.*

Orotherium Marsh.[5] Proposed by Prof. Marsh in 1872 (Aug. 13) as a genus from the Upper Bridger, the type being *Orotherium uintanum* from Henry's Fork and based on a lower jaw. In his original description Marsh distinguishes between this genus and the European genus *Lophiotherium,* but does not give its relationship to *Orohippus,* the type of which consists of upper teeth only. From additional material in the American Museum Collection, which includes upper and lower teeth in association, I am convinced that the type of *Orotherium uintanum,* together with the species *Lophiotherium sylvaticum* Leidy and *Orohippus agilis* Marsh, belong to a separate group from the typical *Orohippus,* as indicated by the more progressive condition of the pre-molars. I hesitate, however, to consider these characters as of full generic importance, preferring to treat the group as a subgenus of *Orohippus.*

---

[1] Arranged in chronological order.
[2] Names of valid genera are in heavy type.
[3] Amer. Jour. Sci., 1872, p. 207. Separates, Aug. 7.
[4] Pal. Bulletin, No. 2, 1872 (Aug. 3), p. 1.
[5] Amer. Jour Sci., 1872, p. 217. *Orotherium* Marsh is preoccupied by *Orotherium* Aymard, 1850.

Oligotomus Cope.[1] The type *O. cinctus* is a lower jaw fragment with broken teeth and is from the Lower Bridger. In his description Cope distinguishes it from *Orotherium* Marsh "in the possession of but two premolars. The inferior molars are six, leaving four true molars." The specimen unquestionably belongs to the genus *Orohippus* and probably to one of Marsh's previously described species.

Eohippus Marsh.[2] Type *E. validus* from the Wasatch of New Mexico. Assuming that there are generic distinctions between *Hyracotherium* of Owen and the horses of the American Wasatch, *Eohippus* stands as the generic name for the American forms from this horizon, since it is the first and only name proposed. Prof. Marsh distinguished this genus from *Orohippus* by the fourth premolar, which he stated was, in both the upper and lower jaw, like the third premolar and not like the first true molar as in *Orohippus.* He remarks further that there are four functional digits in the fore foot and three in the hind foot with a vestige of the fifth metatarsal. This generic description, at least the part referring to the foot structure, appears to have been drawn not from *E. validus* but from fragments associated with the type of *E. pernix* from the Wasatch of Bitter Creek, Wyo., which was described at the same time. There are no metapodials with the type of *E. validus* from which he could have made such determinations, but with the type of *E. pernix* there are both metacarpals and metatarsals. There is no indication of a fifth digit present, however, although he was correct in assuming that there was such a vestige in the pes of the Wasatch horses. I believe that this genus includes not only all of the Wasatch horses but those from the Wind River and possibly those from the Huerfano Basin.

Epihippus Marsh.[3] This name was established in 1878. In his description Marsh states that the genus is found in the Diplacodon Beds of the Uinta Basin, that it is larger than *Orohippus*, has the same number of toes but has the premolars like the molars. No species was mentioned as being the generic type, but *E. gracilis* was the first described, and Dr. Hay in his Bibliography designated it as the type of the genus.

---

[1] Pal. Bull., Nov. 12, 1873, p. 3.
[2] Am. Jour. Sci., XII, 1876, p. 401.
[3] Popular Science Monthly, Apr., 1878, p. 678, footnote.

The characters pointed out by Marsh do not serve to distinguish the Uinta from the Bridger forms. The distinctions are rather in the highly developed mesostyle, in the advanced condition of the second upper and lower premolars, in the crescentic external cusps of the upper molars and in the more perfect development of the cross crests.

Helohippus Marsh.[1] The type of this genus is Marsh's *Lophiodon pumilus* from the Bridger Basin. In 1892 he elevated the species to generic rank and distinguished it from *Orohippus* by the presence of a diastema between the first and second upper premolars. The type of *Orohippus* consisting as it does of loose teeth shows neither the presence nor the absence of a diastema, but referred specimens show various conditions from a considerable diastema to none at all. The character appears to be one of only specific importance. The type of *Helohippus* is barely distinguishable specifically from the type of *Orohippus* both of which bear the same specific name. The former has specific and the latter generic priority.

Protorohippus Wortman.[2] This genus was established by Dr. Wortman in 1896, the type being the skeleton from the Wind River Basin described by Cope as *Hyracotherium venticolum*. The characters which Wortman pointed out as distinguishing this species from all other Wasatch and Wind River horses, which he grouped under *Hyracotherium*, were "no vestige of the fifth digit in the hind foot. Superior molars with sub-crescentic external cusps and having a mesostyle and hypostyle. Fourth superior premolar with only three principal cusps, the fourth (antero-internal in this case) small and more or less in the position of an intermediate. Third superior premolar with four principal cusps, the antero-internal considerably enlarged and shifted inwards to form a cusp analogous with the protocone of the true molars." To take up in order these characters which Dr. Wortman considers of generic value,— *First:* There is what I interpret as a coössified vestigial fifth metatarsal in the type of *H. venticolum*, and this same condition is to be found both in the Bridger and Uinta horses. In a well preserved pes from the Wind River (Amer. Mus. Coll. No. 4848) with which, unfortunately, there are no teeth associated for definite specific determination, there is, on the outer surface of the fourth metatarsal, a well defined facet for a small *free* fifth metatarsal. *Second:* I have not been able to discover a true hypostyle in any of our Eocene horses, even in the Uinta forms. The mesostyle in the specimens of *H. venticolum* is in such a very rudimentary condition as to amount practically to an absence of that structure, which really makes its first appearance in *Orohippus*. *Third:* There certainly is a very marked advance in the development of the third and fourth premolars, especially in the third, shown in a moderate degree only in the type but more strongly in the smaller specimens from the Wind River which have been referred to *H. venticolum.* There are, from the Wind River Beds, specimens which show various stages of premolar development, from the simple triangular teeth of the Wasatch stage to the more or less quadrate teeth seen in No. 4839 figured by Dr. Wortman[1] as representing the extreme condition of this development in the formation, but the range of variation is not more than might occur within generic limits. I feel, therefore, that these characters, which Dr. Wortman has indicated as separating this species generically from all other Wasatch and Wind River species, are not of sufficient value for the purpose and that *Protorohippus* should be considered as synonymous with *Eohippus*.

---

[1] Amer. Jour. Sci., XLIII, 1892, p. 353.
[2] Bull. Am. Mus. Nat. Hist., 1896, p. 104.

If the determinations made above are correct the genera of American Hyracotheres would stand, with relation to the various horizons, as follows:

Eohippus	Wasatch, Wind River, (?) Huerfano.
Orohippus	Bridger.
Epihippus	Uinta.

It remains to compare these three genera with the European forms. Depéret, in his revision of the European Hyracotheres,[2] has not been able to identify any of the American genera with those of Europe, and since material for extended and careful comparisons is lacking in the American Museum Collection, I cannot do better than to accept Prof. Depéret's determinations. Apparently the closest approach between the forms of the two Continents is of *Eohippus* to *Hyracotherium*, in the Lower Eocene and of *Epihippus* to *Lophiotherium* in the Upper Eocene. Between the former Dr. Wortman has pointed out the important difference of a single external cusp on the second upper premolar in *Hyracotherium* and two external cusps in all American species. If one is to rely upon Owen's figures of *Hyracotherium* there is also an important difference between the two genera shown in the intermediate cusps of the upper molars. In *Hyracotherium* these appear to be more separate and distinct than in *Eohippus*, and show less tendency to form cross-crests. Depéret considers *Eohippus* to be an intermediate stage of evolution between *Hyracotherium* and *Pachynolophus.*

---

[1] *Loc. cit.*, p. 105. The figure is slightly exaggerated, the p^3 being less quadrate in outline than the drawing indicates.

[2] Bull. Soc. Geol. de France, 1901, pp. 199–225.

Between *Lophiotherium* and *Epihippus* I may note two distinctions: (1) in the European genus the second upper premolar has a single internal cusp, while in the American form there is a distinct second internal cusp; (2) in *Lophiotherium* the second lower premolar has two anterior and one posterior cusp, and in *Epihippus* this condition is reversed, there being *one anterior* and *two posterior* cusps.

C. Descriptions of Valid Genera and Species.

WASATCH AND WIND RIVER STAGES.

Eohippus *Marsh.*

Syn.: *Protorohippus* Wortman.

Characters: (1) Third and fourth upper premolars with two equal external cusps and one prominent internal cusp, or deuterocone; in the advanced forms a fourth cusp is well indicated, in which case the *third premolar shows more progression than the fourth,* (2) second upper premolar of two equal external cusps and an internal ledge, (3) a disatema between first and second upper premolars, (4) no mesostyle, (5) pes with a vestigial fifth digit, either free or coössified, (6) lower fourth premolar with small entoconid or with entoconid absent, (7) second lower premolar usually with two anterior and one posterior cusps, the second anterior cusp being absent in some species.

(2.)[1] **Eohippus index** *Cope.*

Syn.: *Orotherium index* Cope.

Type locality: Evanston, Wyo. *Type specimen:* A fragment of the left ramus with p_4–m_3 and roots of p_{2-3} (Amer. Mus., Cope Coll. No. 4680).

Characters of type.— (1) Molars rather robust, (2) heel of m_3 moderately stout, (3) m_3 wider than m_2, (4) p_4 without entoconid, at least there is no indication of it in the somewhat weathered tooth, (5) p_2 comparatively very small, (6) cingulum moderately developed on molars, (7) a diastema between p_1 and p_2, (8) ramus thick and stout.

---

[1] The numbers in parenthesis prefixed to the species refer to the chronological list already given (*antea*, pp. 222–230).

Measurements of Type.

	mm.
p_4–m_3	26.5
m_{1-3}	21.3
p_4 transv. diam.	3.8
m_1 antero-post. diam.	5.5
" transv. "	4.1
m_3 antero-post. diam.	9.3
" transv. "	4.8
Depth of ramus at m_2	12.8

This is the smallest of the known American Hyracotheres, the only other types which approach it in size being *E. angustidens* Cope and *E. cuspidatus* Cope, both from New Mexico. Dr. Wortman referred both of these types, as well as much of the material in the American Museum Collection from the Big Horn Basin to this species. *E. cuspidatus* is based on an upper molar belonging to an animal of about the same size as *E. angustidens* to which species I have provisionally referred it rather than to *index* which is from a different locality and possibly different horizon. The extreme slenderness of the molar teeth in *angustidens* is a character of sufficient importance, I think, to distinguish it from the present species. I am also unable to follow Dr. Wortman in his identification of the majority of the Big Horn specimens as pertaining to *E. index*; a few of them do agree fairly well in size and other characters but the greater part of them are materially larger and with proportionately larger and less primitive premolars and should be placed in a separate species.

Referred specimens: Accompanying the type specimen and bearing the same number is a single lower third molar which belongs to a different individual but probably to the same species. From New Mexico a single specimen in the American Museum Collection (No. 4637) is apparently referable here. This specimen exhibits on the third lower premolar a well developed antero-internal cusp. From the Big Horn are several specimens (Nos. 193, 4523, 4589, 4604, 4605, 4620) which are close to the type in size and which show no specific structural differences; they are all fragmentary though and do not furnish additional characters.

(4). **Eohippus angustidens** *Cope.*

Syn.: *Orohippus angustidens* Cope.
(5) *Orohippus cuspidatus* Cope.

Type locality: Rio Gallinas, New Mexico. *Type specimen:* A fragment of ramus with m_{1-3} (Nat. Mus. Coll. No. 1078).

Characters of type: (1) Lower molars very slender, (2) heel of m_3 long and narrow with a single median crest, (3) antero-internal cusp of molars not twinned, (4) m_2 and m_3 of equal transverse diameter, (5) ramus thin.

Measurements of Type.

	mm.
m_{1-3}	24.1
m_1 antero-post. diam.	6.4
" transv. "	4.5
m_3 antero-post. diam.	10.
" transv. "	4.7
Depth of ramus at m_1	12.8

This is one of the smallest species of the genus and differs from *E. index* in the long narrow molars and in the thin, delicate jaw. There are no specimens in the American Museum Collection which approach this type in the slenderness of the molar teeth. The few small specimens from New Mexico and the Big Horn appear to be closer to *index* than to *angustidens*. The type of *Orohippus cuspidatus* Cope, from Rio Gallinas, New Mexico (Nat. Mus. Coll. No. 1077), is a fragment of upper jaw with the fourth milk molar and the first permanent molar. The latter tooth measures in antero-posterior diameter 6.5 mm. and in transverse diameter 7.4 mm. This is about equal to *E. angustidens* in size, to which species it very probably belongs.

(6.) **Eohippus validus** *Marsh.*

Type locality: Rio Gallinas, New Mexico. *Type specimen:* A jaw fragment with p_4–m_3 r.; p_4–m_1 and m_3 l.; p^4–m^1 r.; ? m^2 l. and unimportant skeleton fragments (Yale Mus. Coll.).

Characters of type: (1) Lower molars very short and broad, with m_2 wider than m_3, (2) heel of m_3 large, with external cusp and internal crescent, (3) p_4 comparatively very small and without entoconid, (4) p^4 very small and narrow antero-posteriorly, (5) ramus stout.

Measurements of Type.

	mm.
m^1 antero-post. diam	6.8
" transv. "	9.4
p^4 antero-post. "	5.4
" transv. "	8.

	mm.
p_4–m_3	31.7
m_{1-3}	26.
m_1 antero-post. diam	7.
" transv. "	5.3
m_3 antero-post. diam	11.2
" transv. "	6.
p_4 " "	4.2

This species is the generic type for all known Wasatch and Wind River horses. It is quite the most primitive species of the genus; the very small, narrow and simple fourth upper premolar is not duplicated in any other type or indeed in any other specimen which I have examined.

(8.) **Eohippus cristonensis** *Cope.*

Syn.: *Orotherium cristonensis* Cope.
(9) *Orotherium loevii* Cope.

Type locality: Rio Gallinas, New Mexico. *Type specimen:* Lower jaws (Nat. Mus. Coll. No. 1002).

Characters of type: (1) Molars of moderate robustness, (2) heel of m_3 extremely broad and heavy, (3) p_4 with small entoconid, (4) p_3 with rudimentary antero-internal cusp, (5) long diastema between p_1 and p_2, (6) cingulum weak and not continuous.

Measurements of Type.

	mm.
p_2–m_3	45.5
m_{1-3}	27.
m_1 antero-post. diam.	7.
“ transv. “	5.2
m_3 antero-post. “	11.7
“ transv. “	5.8
p_4 antero-post. “	6.2
“ transv. “	4.7
Depth of ramus at m_2	15.

The large basin-shaped heel of the last molar of this specimen is not found in any other Wasatch type, although this seems to be a character of considerable variability in the Hyracotheres. The size and general proportions of the teeth, however, distinguish this species from any previously described, with the exception, perhaps, of Cope's *Hyracotherium vasacciense* from Evanston, the type of which is a single (?) second lower molar agreeing pretty closely with the corresponding tooth in the present species.

The type of *Orotherium loevii* Cope (Nat. Mus. Coll. No. 1128), from New Mexico, was regarded by Wortman as being a small variety of *E. cristonensis.* The type is a very inferior one consisting, as it does, of jaw fragment with badly worn and broken p_2–m_2. It is considerably smaller than the type of *cristonensis*, but the proportions of the teeth are much the same and there is a distinct entoconid on the fourth premolar.

Measurements of Type of Orotherium loevii.

	mm.
p_2–m_2	28.5
m_1 antero-post. diam.	6.
“ transv. “	4.2
p_4 antero-post. “	5.5
“ transv. “	3.5
Depth of ramus at m_2	14.

Referred specimens: No. 4634, Amer. Mus. Coll., from the type locality is the closest approach to the type of the present species of any specimens in the collection, and this differs in having bifid antero-internal cusps and a smaller heel. No. 4636, also from the type locality, agrees in having the cusps not twinned but has a short heel. No. 165 from the Big Horn Basin was provisionally referred by Wortman but differs, as he pointed out, in having a short heel, bifid cusps and no diastema between p_1 and p_2. It probably does not pertain to *E. cristonensis*.

(12.) **Eohippus etsagicus** *Cope.*

Syn.: *Systemodon etsagicus* Cope.

Type locality: Big Horn Basin, Wyo. *Type specimen:* A jaw fragment with p_4–m_2 l., roots of p_{2-3} and alveolus of p_1 (Amer. Mus., Cope Coll. No. 4600).

Characters of Type: (1) Molars moderately stout, (2) p_4 with entoconid, (3) no diastema between p_1 and p_2, (4) ramus deep.

Measurements of Type.

	mm.
p_4–m_2	23.
m_1 antero-post. diam.	8.
" transv. "	5.4
p_4 antero-post. "	6.5
" transv. "	4.5
Depth of ramus at p_4	19.

Prof. Cope figured this specimen in his Tertiary Vertebrata, and in the explanation of the plate applied the name *Systemodon etsagicus.* There appears to be no other reference to the specimen. It very clearly is a *Hyracothere* and is distinct from any previously described species of *Eohippus.* In size it is about equal to *E. cristonensis* but differs (1) in the depth of the ramus, (2) in having no entoconid on the fourth premolar, (3) in the absence of the diastema. The specimen is of importance as being the only type from the Big Horn Basin described previously to Dr. Wortman's revision.

Referred specimens: Two specimens in the American Museum Collection (Nos. 228, 4597) appear to belong to this form; No. 4597 shows a double-rooted first lower premolar and but a slight indication of the antero-internal cusp on the third premolar.

(13.) **Eohippus cristatus** *Wortman.*

Syn.: *Hyracotherium cristatum* Wortman.

Type locality: Grey Bull River, Big Horn Basin, Wyo. *Type specimen:* A lower jaw fragment with p_3–m_2 r. (Amer. Mus. Coll. No. 258b). Paratype; a jaw fragment with m_3 (No. 240).

Characters of type: (1) Jaw and teeth robust, (2) p_4 without entoconid and with antero-internal cusp weak, (3) p_3 with a single anterior cusp, (4) cross crests of molars strongly developed, (5) heel of m_3 stout.

Measurements of Type.

	mm.
p_3–m_2	36.
m_{1-2}	20.
m_1 antero-post. diam.	9.5
" transv. "	6.8
p_4 antero-post. "	8.
" transv. "	5.5
Paratype.	
m_3 antero-post. diam.	14.5
" transv. "	7.3

With the exception of those specimens which Cope and Wortman have referred to *Hyracotherium tapirinum*, this is the largest of the Wasatch horses and may be distinguished by the absence of the antero-internal cusp on the third premolar and the posterior position of the homologous cusp on the fourth premolar. Compared with *E. craspedotus* of the Wind River, the present species has more slender teeth and the fourth premolar is comparatively much smaller and with a narrower heel, also the cross-crests of the molars are better developed.

Referred specimens: Nos. 4650, 4653, 4656 and 4655, Amer. Mus. Coll., are probably referable to this species, but do not add any characters since they consist of lower molars only.

(14.) **Eohippus montanus** *Wortman.*

Syn.: *Hyracotherium* (*Pliolophus*) *montanum* Wortman.

Type locality: Big Horn Basin, Wyo. *Type specimen:* Fragments of both rami, with m_{2-3} l., p_4 and roots of p_{1-3} r. (Amer. Mus. Coll. No. 4593).

Characters of Type: (1) Molars robust, (2) heel of m_3 of moderate size, (3) p_4 with small entoconid, (4) p_1 double rooted, (5) no diastema between p_1 and p_2.

Measurements of Type.

	mm.
p_1–m_3 (approx.)	52.5
m_{1-3}	28.
m_3 antero-post. diam.	11.3
“ transv. “	6.
p_4 antero-post. “	6.5
“ transv. “	4.6
depth of ramus at m_2	15.5

Dr. Wortman established this species on the distinguishing characters of “(1) the absence of any diastema between the first and second premolars, and (2) the two rooted condition of the first premolar.” The first character is observed in the type of *E.* (*Systemodon*) *etsagicus* Cope from the same locality but it is not possible to determine whether the premolar was double rooted or not. The Cope type is deep-jawed, has more slender molars and there is no distinct entoconid on the fourth premolar, characters which would seem to indicate that the present species is distinct.

Referred specimens: The only specimen in the collection which appears to be referable here is No. 221, a fragmentary jaw from the Big Horn Basin, which shows the additional character of a strong antero-internal cusp on the third premolar.

Eohippus resartus sp. nov.

Type locality: Big Horn Basin, Wyo. *Type specimen:* A portion of a left ramus with p_3–m_2 l. and, in somewhat doubtful association, fragments of upper jaws with p^4–m^1 l., m^{2-3} r. (Amer. Mus., Cope Coll. No. 4657).

Characters of type: (1) Lower molars stout and with cross crests well developed, (2) p_4 without entoconid, (3) p_3 with well developed antero-internal cusp, (4) ramus deep and massive.

Measurements of Type.

	mm.		mm.
p^4–m^3	38.	p_3–m_2	36.4
m^{1-3}	30.	m_1 antero-post. diam.	10.
m^1 antero-post. diam.	10.	“ transv. “	6.5
“ transv. “	11.5	p_4 antero-post. “	8.
p^4 “ “	10.	“ transv. “	5.5

This species is proposed for the purpose of embracing the various specimens from the Big Horn Basin which have been referred by Cope and Wortman to *Hyracotherium* (*Orohippus*) *tapirinum* Cope, of the New Mexican Wasatch, a type which is not generically determinable and which, I think, should be abandoned as useless for the reference of additional material.

The type is a fragment of lower jaw with very badly worn second and third molars (Nat. Mus. Coll. No. 1064). It was originally described as *Orohippus tapirinus,* was later referred by Cope to the genus *Hyracotherium,* and when *Systemodon* was discovered in the Big Horn Basin, Cope made it the type of that genus. Dr. Wortman, however, in his treatise on the subject, considered that Cope's original determination of the specimen as a horse was the correct one. The only reason, which I can determine, for considering it a horse is the fact that in the last molar the oblique ridge which connects the anterior pair of cusps with the posterior pair has its anterior termination, as nearly as can be made out from the worn teeth, between the two anterior cusps and not at the posterior face of the external cusp as in the majority of specimens of *Systemodon* from the Big Horn. There are from the Big Horn specimens which are intermediate in this respect between *Eohippus* and *Systemodon* and which do not fall satisfactorily into either genus. The present species is the largest of the Wasatch or Wind River Hyracotheres, exceeding in size *E. craspedotus* and *E. cristatus.* From the former it is distinguished by the strong cross crests of the lower molars and from the latter by the presence of a second anterior cusp on the third premolar and by the subequal anterior cusps of the fourth premolar.

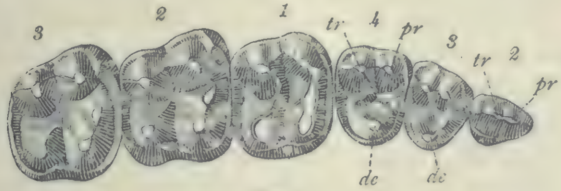


Fig. 1.

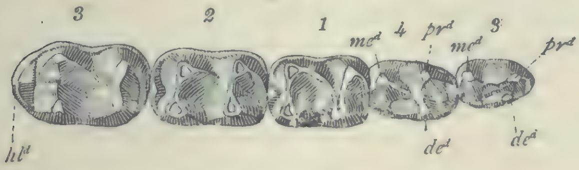


Fig. 2.

Figs. 1 and 2. *Eohippus resartus.* (After Wortman.)

Fig. 1. Upper teeth, crown view (composition from Nos. 139 and 212). Wahsatch, Big Horn. × $\frac{3}{2}$.

Fig. 2. Lower teeth, crown view. Type specimen No. 4657 (third molar from No. 143*a*). Wahsatch, Big Horn. × $\frac{3}{2}$.

Abbreviations: *pr.* = protocone, *de.* = deuterocone, *tr.* = tritacone, pr^d. = protoconid, de^d. = deuteroconid, me^d. = metaconid, hl^d. = hypoconulid.

Referred specimens include Nos. 139 and 212 (Fig. 1), both from the Big Horn Basin. The first of these is a palate with the molars and third and fourth premolars and the second has molars and second and third premolars in association with a lower molar. These two specimens combined give a fairly complete representation of the upper teeth of this species. The characters of importance are (1) metaconules not clearly defined, (2) strong parastyle on third and fourth premolars, (3) outer cusps of second and third premolars placed close together, (4) a postero-internal ledge on second premolar.

The specimens in the National Museum Collection from New Mexico which have been referred by Cope to *H. tapirinum* are probably referable to the present species, although in the absence of premolar teeth it is not possible to definitely separate them from Wortman's *E. cristatus*. They do not agree well with Cope's type of *tapirinum* in which the second molar has a much greater transverse diameter than the third.

Eohippus borealis sp. nov.

Type locality: Big Horn Basin, Wyo. *Type specimen:* Lower jaws with p_2–m_3 of both sides (Amer. Mus. Coll. No. 214).

Characters of type: (1) Molars moderately stout, (2) heel of m_3 short and stout but not broad, (3) m_2 about equal to m_3 in transverse diameter, (4) p_4 without entoconid, (5) p_3 with two anterior cusps, (6) diastema between p_1 and p_2, (7) cingulum weak on p_4, moderate on molars, (8) jaw stout but not deep.

Measurements of Type.

	mm.
p_2–m_3	44.
m_{1-3}	26.
m_1 antero-post. diam.	7.2
" transv. "	5.2
m_3 antero-post. "	11.
" transv. "	5.4
p_4 antero-post. "	6.5
" transv. "	4.6
Depth of ramus of m_2	18.

In the American Museum Collection there are between two and three hundred specimens of Hyracotheres from the Big Horn Basin. These consist mainly of fragmentary upper and lower jaws. In only a few instances are there upper and lower teeth in association. A large proportion of the specimens, perhaps one third, appear to belong to a single medium sized species. In the general structure of the lower teeth they do not differ very materially from the type of *E. index* from Evanston, and Dr. Wortman has referred the majority of these Big Horn specimens to this species. As I have mentioned before, however, it seems to me that there is too great a difference in size between the Evanston type and the majority of the referred specimens from the Big Horn Basin to be bridged over by a single species, and I propose this name to embrace these numerous specimens and also a few from the Wind River which appear to be referable to the same species. This form appears not to be represented from the Wasatch of New Mexico. It may be distinguished from the various New Mexican types as follows; from *E. cristonensis* Cope by (1) the absence of an entoconid on the fourth premolar, (2) the relatively smaller third molar and shorter narrower heel; from *E. angustidens* Cope by greater size and relatively broader molars; from *Hyracotherium tapirinum* Cope, by size; and from *E. validus* Marsh by (1) relatively narrower molars and (2) larger fourth premolar. From the three types from the Big Horn Basin, *E. etsagicus* Cope, *E. montanus* Wort. and *E. cristatus* Wort., it is clearly distinguishable. In the first two species there is no diastema between the first and second premolars, and in the last (*E. cristatus*) there is no antero-internal cusp on the third premolar, and the species is also much larger compared with *Hyracotherium vasacciense* Cope, from Evanston, the present species has more slender molars.

Referred specimens: Among the more important specimens in the collection which may be referred to this species are Nos. 179, 4498, 4583, 4602, 4613, 4624. One of these, No. 4613[1], has upper molars associated with lower jaw; the upper molars agree well with those of No. 4602, and as the latter specimen has, in addition to the upper molars the third and fourth premolars, it may be selected for description of the upper dentition of *E. borealis.* (1) The molars show a moderate parastyle, (2) have the protoconules distinct and the metaconules well separated on first and second teeth, (3) last molar with its posterior border square cut, a condition materially different from that seen in some other specimens of about the same size in which the last molar shows strong lateral compression at the metacone, giving the tooth almost a triangular outline. These latter probably represent a species distinct from the present one.

The measurements of No. 4602, which is a slightly smaller individual than the type, are:

p^3–m^3	35.
m^{1-3}	22.5
m^1 antero-post. diam.	7.
" transv. "	8.5
m^3 antero-post. "	7.5
" transv. "	9.
p^4 antero-post. "	6.
" transv. "	7.3

---

[1] See Bull. Am. Mus. Nat. Hist., 1896, p. 100, figs. 9 and 10.

The single lower molar from Evanston, Wyo., described by Cope as *Lophiotherium vasacciense,* is a type to which the reference of other specimens from widely separated localities and possibly different geological horizons must be attended with much uncertainty. The lower jaw (Amer. Mus. Cope Coll. No. 4659), from the Big Horn Basin, which Dr. Wortman has described and figured as representing this species, agrees with the type, as he states, fully as well as any of the specimens from this locality do, but it seems preferable, for the reason given above, not to consider it as representing *vasacciense* but rather as a large deep-jawed variety of *E. borealis.* Aside from size and the depth of jaw it differs from the present species in having a weaker deuteroconid on the third premolar and a shorter heel on the third molar.

The measurements of No. 4659 are:

p_2–m_3 (approx.)	45.
m_{1-3}	26.
m_3 antero-post. diam	10.
depth of ramus at m_1	20.

Nos. 4504 and 4660 pertain to this variety.

Several specimens (Nos. 4617, 4596, 4578, 4591, 4626) represent a smaller variety of *E. borealis,* being closer to this species than to *E. angustidens* in which the molars are extremely slender. No. 4578 has the molar series measuring 24 mm. as compared with 26 mm. in the type. The other specimens are intermediate in size.

From the Wind River there are several upper and lower jaws (Nos. 12807, 12795, 12799) from the lower level (Cottonwood Draw and Bridger Creek) which I am unable to distinguish from this species.

(10.) **Eohippus craspedotus** Cope.

Syn.: *Hyracotherium craspedotum* Cope.

Type locality: Wind River Basin, Wyo. *Type specimen:* Parts of both lower jaws with m_{1-3} r., p_2 and p_4–m_1 l. (Amer. Mus., Cope Coll. No. 4830).

Character of type: (1) Molars very robust, with low massive cusps, (2) m_2 considerably wider than m_3, (3) heel of m_3 broad and very heavy, (4) cross crests of molars but little developed, (5) p_4 without a distinct entoconid, (6) very short diastema between p_1 and p_2, (7) prominent posterior cusp on p_2.

Measurements of Type.

	mm.
p_2–m_3	56.
m_{1-3}	33.
m_1 antero-post. diam.	9.
" transv. "	7.
m_3 antero-post. "	13.5
" transv. "	7.5
Depth of ramus at m_2	20.

This is the largest species found in the Wind River and nearly as large as any from the Wasatch. It is readily distinguishable by the short broad teeth and the low, obtuse and well separated cusps of the molars.

Referred specimens: As probably belonging to this species is a crushed skull (No. 4831) with the molars and third and fourth premolars in fine preservation. Both Cope and Wortman have referred this specimen to this species. The premolars show but very slight progression, the third and fourth being very simple triangular teeth, quite distinct in this respect from *E. venticolus,* from the same beds in which the third premolar has the second internal cusp well indicated. The molars show less development of the parastyle than is seen in the larger Wasatch species.

A second specimen (No. 12819) which is either referable to this species or to one undescribed has upper and lower jaws in association. The lower molars are more slender than in the type and there is no trace of an entoconid on the fourth premolar. The upper teeth are similar to No. 4831. Both of these referred specimens are from the Wind River.

Measurements of No. 4831 are:

p^2–m^3 (approx.)	57.
m^{1-3}	27.5
m^1 antero-post. diam.	9.
" transv. "	10.7
p^4 antero-post. "	7.2
" transv. "	9.6

(11.) **Eohippus venticolus** *Cope.*

Syn.: *Hyracotherium venticolum* Cope, 1881.
Protorohippus venticolus Wortman, 1896.

Type locality: Alkali Creek, Wind River Basin, Wyo. *Type specimen:* Skull, jaws and large part of skeleton. (Amer. Mus., Cope Coll. No. 4832).

Characters of type: Lower dentition, (1) molars moderately stout, (2) heel of m_3 broad and heavy, (3) m_1 equal to m_3 in transverse diameter, (4) p_4 with well developed entoconid, (5) p_3 with two sub-equal anterior cusps and no posterior cusp, (6) diastema between p_1 and p_2; Upper dentition, (1) parastyle moderate, (2) intermediate cusps well indicated on all molars, (3) p^4 triangular in outline, (4) p^3 more advanced than p^4, the antero-internal cusp being fairly well developed, (5) p^2 with postero-internal ledge, (6) short diastema between p^1 and p^2.

Measurements of Type.

	mm.		mm.
p^2–m^3	45.	p_2–m_3	48.8
m^{1-3}	24.3	m_{1-3}	28.2
m^1 antero-post. diam	8.1	m_1 antero-post. diam	8.
" transv. "	10.5	" transv. "	6.
m^3 antero-post. "	8.3	m^3 antero-post. "	12.
" transv. "	10.3	" transv. "	6.5
p^4 antero-post. "	7.		
" transv. "	9.		
Length of skull from occipital condyles to tip of nasals	138.	p_4 antero-post. diam	6.8
		" transv. "	5.5
Length of femur	188.	Length of humerus	96.
" " tibia	122.	" " ulna	116.
" " mt. III	68.	" " radius	93.
		" " mc. III	51.

This is the most important specimen of a Hyracothere from our lower Eocene, and it has been thoroughly described and figured by Cope. The characters of the upper premolars serve at once to distinguish it from any Wasatch species, while its size, and the proportions of the lower molars; separate it from *E. craspedotus* of the same beds.

Referred specimens: There are no other specimens in the collection which can with absolute certainty be referred to this species although there are two (Nos. 4837, 4839), each with upper premolars, which represent either a small variety or a closely allied species, since both present the character seen in the third premolar of the type. A third specimen (No. 4834), lower jaw, is also smaller than the type and has no entoconid on the fourth premolar although the premolars are relatively larger.

HUERFANO STAGE.

? Eohippus.

In the small collection of fossils obtained by Prof. Osborn and Dr Wortman in the Huerfano Basin in 1897 there are a few fragmentary remains of Hyracotheres, including portions of two lower jaws, and representing two species. One (No. 2685), a small slender jawed type, is recorded as coming from the lower beds, and the other (No. 2658a), a medium sized species with short broad teeth, is from the middle or upper beds. I am unable to determine definitely the generic position of these two specimens. The fourth premolar is preserved in both jaws and, while the entoconid is rather more highly developed than in the Wind River species, yet the tooth does not show the progressive character found in *Orohippus.* Until the upper teeth are known the reference of the Huerfano horses to either *Eohippus* or *Orohippus* must be more or less conjectural. Prof. Osborn has referred[1] the smaller of the two specimens to the Wind River genus, provisionally.

Measurements of No. 2685

	mm.
p_2–m_3 (approx.)	44.
m_{1-3}	25.
m_3 antero-post. diam	10.8
" transv. "	5.4
Depth of ramus at m_2	13.5

Measurements of No. 2685a

	mm.
p_3–m_2	21.4
m_2 transv. diam	6.
Depth of jaw at m_2	15.3

BRIDGER STAGE.

Orohippus *Marsh*, 1872.

Syn.: *Helotherium* Cope, 1872.
Oligotomus Cope, 1873.
Helohippus Marsh, 1892.

Characters: (1) Third and fourth upper premolars either molariform or well advanced toward that condition, *the fourth always showing* progression equal to the third, (2) second upper premolar with two external cusps and, in advanced species, a small internal cusp, (3) first upper premolar double rooted, (4) diastema between first and second upper premolars either present or absent, (5) mesostyle present (practically absent in *O. major*), (6) lower fourth premolar molariform, (7) third premolar, usually, with two anterior and one posterior cusp, (8) diastema between lower first and second premolar either present or absent.

(16.) **Orohippus pumilus** *Marsh.*

Syn.: *Lophiodon pumilus* Marsh.
(9) *Helotherium procyoninum* Cope.

Type locality: "Marsh's Fork,"[2] Bridger Basin, Wyo. *Type specimen:* A right maxilla with p^3–m^2 and roots of p^{1-2} (Yale Mus. Coll.).

---

[1] Bull. Amer. Mus., 1897, p. 258.

[2] I cannot determine the position of "Marsh's Fork" but it probably is one of the numerous small dry creeks leading into either Smith's or Black's Fork, and hence in the Lower Bridger. There is a Marsh Creek indicated on some maps in the upper part of the Green River Basin, north of Piney Creek, but I think this must be beyond the northern limits of the Bridger exposures.

Characters of type: (1) Teeth considerably compressed antero-posteriorly, (2) parastyle much reduced, (3) mesostyle rudimentary, at least on m^{1-2}, (4) strong internal ledge on p^2, as indicated by roots of the tooth, (5) moderately advanced toward full molariform condition, (6) short diastema between p^1 and p^2.

Measurements of Type.

p^2–m^2	29.5
m^{1-2}	13.
m^2 antero-post. diam.	6.8
" transv. "	8.

Prof. Marsh in 1892 elevated this type to separate generic rank giving it the name *Helohippus.* He distinguished the genus by "a diastema between the first and second premolars, and the last premolar like the first molar." These characters are apparently meant as distinctions from *Orohippus,* the type of which consists of four loose teeth, and the presence or absence of a diastema cannot be determined although it is probable that there was one. There is no fourth premolar with the typical *Orohippus* but the third premolar certainly does not show any characters separating it from the present species generically. Specific distinctions between the two species are confined principally to the greater antero-posterior compression of the teeth in the present form.

The single third upper molar from Cottonwood Creek, Hor. B. (Amer. Mus., Cope Coll. No. 5052), described by Cope as *Helotherium procyoninum* resembles the present species pretty closely although the mesostyle is rather better developed than in the first and second molars of *O. pumilus.* The specimen surely belongs to this genus and very probably to this species.

The measurements of *H. procyoninum* are:

	mm.
m^3 antero-post. diam.	7.
" transv. "	8.3

(17.) **Orohippus ballardi** *Marsh.*

Syn.: *Lophiotherium ballardi* Marsh.
(22) *Oligotomus cinctus* Cope.

Type locality: Grizzly Buttes, Lower beds, Bridger Basin, Wyo. *Type specimen:* Fragment of left ramus with m_{2-3} (Yale Mus. Coll.).

Characters of type: (1) Molars short and broad with outer and inner cusps placed well apart, (2) heel of m_3 short and not basin shaped, (3) cingulum weak.

Measurements of Type.

	mm.
m_2 antero-post. diam.	6.7
" transv. "	4.7
m_3 antero-post. diam.	9.3
" transv. "	4.4

This is one of the smaller Bridger forms, about equal in size to *O. pumilus* with which it may prove to be identical when more complete material is secured.

Referred specimens: Referable to *O. ballardi* are two fragments of jaws from horizon B. (Nos. 11627, 12648a). One specimen (No. 12122), from Dry Creek, Hor. C., is considerably smaller than the type and smaller than anything else in the American Museum Collection. The molar series measures, in millimeters, 21.5, $m_{1-2} = 13.$, width of $m_1 = 4.5$.

Oligotomus cinctus Cope from the same horizon is not specifically distinguishable from this species and should be included under it.

Measurements of O. cinctus.

	mm.
p_2-m_1 (approx.)	26.
m_1 antero-post. diam.	7.
p_4 antero-post. "	6.3
" transv. "	5.
Depth of ramus of p_2	12.

(18.) **Orohippus typicus** nom. nov.[1]

Type locality: Henry's Fork[2] (?), Upper beds, Bridger Basin, Wyo. *Type specimen:* Loose teeth, p^3, m^1, $m^{?3}$ l.; m^3 r. (Yale Mus. Coll.).

Characters of type: (1) Parastyle rudimentary, (2) mesostyle rudimentary, (3) molars broad antero-posteriorly (4) third and (?) fourth premolars well advanced toward molariform condition but not fully molariform.

Measurements of Type.

	mm.
m^3 antero-post. diam.	7.
" transv. "	8.

This is the type of the genus. Since this species is not generically distinct from the species described by Marsh the year before as *Lophiodon pumilus,* and since the reference to *Lophiodon* was erroneous, a new specific name is necessary to designate this species, and the name *typicus* is assigned. The specific differences between this form and *O.* (*Lophiodon*) *pumilus* are slight. So far as comparisons can be made, about the only differences are in the greater antero-posterior diameter of the molars in *O. typicus* and in the slightly different form of the third and fourth premolars. The two types agree in the rudimentary condition of parastyle and mesostyle. Although *O. typicus* is recorded as coming from Henry's Fork, and hence from the upper beds, it is a rather primitive form such as might be expected from the lower horizons. This species also compares in size with *O. ballardi.*

---

[1] To replace *O. pumilus* Marsh, preoccupied.

[2] In the original description of this species the type is recorded as coming from Grizzly Buttes.

Referred specimens: In the American Museum Collection are two specimens (Nos. 12121, 11631) which are pretty certainly referable to this species, but neither is sufficiently complete to afford any additional characters.

Orohippus progressus sp. nov.

Type locality: Twin Buttes, Hor. C., Bridger Basin, Wyo. *Type specimen:* Fragmentary skull with molar and premolar teeth. (Amer. Mus. Coll. No. 12120). Collected by Mr. C. S. Mead, 1904.

Characters of type: (1) Parastyle well developed, (2) mesostyle moderately developed on molars and on p^3 and p^4, (3) molars broad antero-posteriorly, (4) p^3 and p^4 each with two equal internal cusps but with outlines not fully quadrate, (5) p^2 three rooted but the internal ledge is narrow and abruptly sloped, (6) moderate diastema between p^1 and p^2.

Measurements of Type.

	mm.
p^2–m^3	39.
m^{1-3}	20.
m^1 antero-post. diam.	7.2
" transv. "	8.7
m^3 antero-post. "	7.
" transv. "	8.3
p^4 antero-post. "	6.8
" transv. "	8.

A small species from the upper beds which shows a very general and uniform progression towards *Epihippus* of the Uinta formation. In size the species is about the same as *O. typicus,* but it is distinguished from it by the greater development of the parastyle and mesostyle and the less rounded outline of the last molar.

(23.) **Orohippus major** *Marsh.*

Type locality: Millersville, Lower beds, Bridger Basin, Wyo. *Type specimen:* An upper jaw fragment with m^{2-3} r. and loose m^2 l. (Yale Mus. Coll.).

Characters of type: (1) Parastyle moderately developed, (2) mesostyle but slightly indicated on m^3, absent on m^2, (3) m^3 more quadrate in outline than in other Bridger species, (4) external cusps much flattened.

Measurements of Type.

	mm.
m^2 antero-post. diam.	8.5
" transv. "	11.
m^3 antero-post. "	8.5
" transv. "	10.

This is the largest of the Bridger horses and probably the most primitive. The molars show, in the practically absent mesostyle and in their outline, a rather strong resemblance to the molars of *Eohippus craspedotus* from the Wind River, and the discovery of more complete material may compel its removal from the genus *Orohippus.*

Referred specimens: A lower jaw (No. 11634) from Church Buttes, Hor. B., supporting the second and third molars, agrees with the type in size and is probably referable to it. The characters are, (1) heel of m_3 moderately stout, (2) cingulum heavy, (3) m_2 short and with greater transverse diameter than m_3, (4) ramus very robust.

Measurements.

	mm.
m_2–$_3$	20.7
m_3 antero-post. diam.	12.
" transv. "	6.
m_2 " "	6.4
Depth of ramus at m_2	18.

A lower jaw (No. 11633) from Henry's Fork, with the fourth milk molar and first and second true molars, equals the type in size and may belong to the species. Of interest in this specimen is the great length of the diastema between the first and second premolars, a character which separates it at once from the large advanced forms of the upper beds which I have grouped under the sub-genus *Aminippus* (*Orotherium*) Marsh, and which includes the species *agilis, uintanus* and *sylvaticus.*

Measurements of No. 11633.

	mm.
m_1–$_2$	18.5
m_1 antero-post. diam.	9.
" transv. "	6.3
Length of diastema	+10.

(24.) **Orohippus osbornianus** (*Cope*).

Syn.: *Hyracotherium osbornianum* Cope.

Type locality: Black's Fork, Hor. B., Bridger Basin, Wyo. *Type specimen:* Lower jaw fragment with m_1 and roots of p_{3-4} and m_{2-3} (Amer. Mus., Cope Coll. No. 5051).

Measurements of Type.

	mm.
p_4–m_3 (approx.)	34.
m_1–$_3$ (approx.)	27.
m_1 antero-post. diam.	8.
" transv. "	5.5
Depth of ramus at m_2	14.

The type of this species exhibits but few characters for comparison, but it represents a medium sized form from the lower horizon and does not appear to be referable to any previously described member of the genus.

Referred specimens: No. 12648, consisting of skull, jaws and a large part of the skeleton, was obtained for the American Museum by the writer in 1905 in the lower levels of the Bridger formation, near Granger, and agrees reasonably well so far as comparisons can be made with the type of this species, the chief differences being in the depth of the ramus, a character of variability in Eocene horses. The dental characters of this referred specimen are: *upper series,* (1) Parastyle strong, (2) mesostyle remarkably well developed on all teeth posterior to p^1, (3) p^3 and p^4 primitive, p^4 being considerably more quadrate than p^3, (4) p^2 with no distinct internal cusp, (5) diastema very short on one side and absent on the other, (6) p_1 double rooted, (7) canine very small and weak, not larger than p^1; *lower series,* (1) molars moderately robust, (2) cingulum very heavy, (3) heel of m_3 short and stout, (4) p_3 without entoconid, (5) diastema about equal to antero-posterior diameter of p_2, (6) canine very weak, (7) short diastema in front of canine, (8) incisors of equal size and with expanded and sharp cutting edges, (9) ramus thin.

Measurements of No. 12648.

	mm.		mm.
p^1–m^3	49.3	p_2–m_3	46.4
m^{1-3}	24.	m_1–$_3$	26.
m^1 antero-post. diam.	7.9	m_1 antero-post. diam.	7.3
" transv. "	9.5	" transv. "	5.7
m^3 antero-post. "	8.	m_3 antero-post. "	10.5
" transv. "	9.	" transv. "	5.4
p^3 antero-post. "	7.2	p_4 antero-post. "	7.
" transv. "	8.4	" transv. "	5.4
		depth of ramus at m_2 (increased by crushing)	16.

Some of the more important measurements of the skull and skeletal parts are:

	mm.
Length of skull	140.
“ “ nasals	64.
“ “ humerus	102.
“ “ mc. II	45.
“ “ “ III	50.
“ “ “ IV	42.
“ “ “ V	34.5
“ “ mt. III	70.
“ “ “ IV	65.

Aside from the skull and jaws there are preserved all of the pre-sacral vertebræ, parts of both fore and hind limbs including nearly complete manus and pes, a few ribs, fragments of pelvis and three sternal bones. The skull is badly crushed and the hind limbs and vertebræ are broken or weathered. A few characters of importance are to be noted, however, There are parts of thirty presacral vertebræ preserved; of these the seven cervicals are clearly distinguishable, of the remaining twenty-three dorso-lumbars fifteen are rib-bearing and eight seem to be lumbars. In the fore limb there is no material difference from *Eohippus venticolus*, the fibula has a very slender shaft but it is not interrupted. In the manus and pes there is a slight advance over *E. venticolus* in the reduction of the lateral digits, the ischium is remarkably long and the blade of the scapula relatively broad in comparison with *Hyrachyus.*

Five other specimens of lower jaws in the collection (Nos. 12656, 12657, 11622, 11623, 11624) agree with the type in measurements and, with No. 12648, in the development of the premolar cusps, but all differ from the latter in having more robust jaws, one specimen (No. 11624) has canines fully twice the size of those of No. 12648. This size of the canines may very easily be a sexual character, though.

Orohippus atavus sp. nov.

Type locality: Mouth of Cottonwood Creek, Lower beds, Bridger Basin, Wyo. Collected by Dr. O. P. Hay, 1903. *Type specimen:* A fragmentary skull and portions of a hind limb (Amer. Mus. Coll., No. 11625).

Characters of type: (1) Parastyle strong on first and second molars, weak on other teeth, (2) mesostyle only slightly indicated, except on m_2, where it is well developed, (3) p^3 and p^4 very primitive; the p^3 is nearly triangular in outline, the p^4 has the postero-internal cusp well developed and is more quadrate in outline than p^3, (4) p^2 with no distinct internal cusp, (5) moderate diastema, (6) canines of moderate size.

Measurements of Type.

	mm.
p^2–m^3	44.3
m^{1-3}	23.
m^1 antero-post. diam.	7.6
" transv. "	9.3
m^3 antero-post. diam.	7.6
" transv. "	8.6
p^4 antero-post. "	6.3
" transv. "	8.
Diastema	5.5

A medium sized species from the lower beds and, excepting *O. major,* the most primitive of any yet found in the Bridger. The third premolar shows but little advance over *Eohippus venticolus.* The fourth premolar, however, has the postero-internal cusp, or tetartacone in a higher developed condition than is found in any Wind River specimens. The cusp is nearly as large as the deuterocone but its position is less internal. It is the development of this fourth premolar beyond that of the third, together with the presence of a mesostyle, which places the species in the genus *Orohippus* instead of *Eohippus.*

This species may readily be distinguished from *O. osbornianus* by its weak development of mesostyle, as well as by the moderate diastema and by the more primitive condition of the third and fourth premolars.

Referred specimens: Provisionally referred to this species is a lower jaw, (No. 11626) from Grizzly Buttes, which shows a very primitive condition of the third premolar, there being but a single anterior cusp and a large unicuspid heel, which is the condition of the second premolar in most species of Bridger horses. The fourth premolar is a molariform tooth, however, the two posterior cusps being sub-equal.

Measurements of this jaw are:

	mm.
p_3–m_3	40.
m_{1-3}	26.
m_1 transv. diam.	5.5

Subgenus **Aminippus** nom. nov.[1]

Several species of the Equidæ from the Upper Bridger are decidedly more advanced than any from the lower part of the formation, but the differences are here regarded as of only subgeneric value. *Orotherium* Marsh, 1872, is the only generic name founded upon a species unquestionably from this level; as this is preoccupied it becomes necessary to propose a new name for these more progressive forms and the name *Aminippus* is chosen. *Orotherium uintanum* Marsh is the type of the subgenus, which includes the species *sylvaticus* of Leidy and *agilis* of Marsh.

---

[1] To replace *Orotherium* Marsh, preoccupied. *Aminippus* = better horse, *i. e.*, more like the modern forms.

Characters: (1) Third and fourth upper premolars molariform, (2) second upper premolar with internal cusp, (3) no diastema between first and second upper premolars, (4) mesostyle moderately developed, (5) second lower premolar with single anterior and single posterior cusps, (6) no diastema between first and second lower premolars, (7) third and fourth lower premolars molariform.

15. **Orohippus (Aminippus) sylvaticus** *Leidy.*

Syn.: *Lophiotherium sylvaticum* Leidy.

Type locality: Henry's Fork, Upper Beds, Bridger Basin, Wyo. *Type specimen:* A portion of the left ramus with p_4–m_1 and m_3 (Nat. Mus. Coll. No. 3753). This is the first form described from the Bridger; in fact, the first species of *Hyracothere* described from any of the American Eocene stages.

Characters of type: (1) p_3[1] and p_4 molariform, but with p_3 very narrow anteriorly, (2) anterior pair of cusps on both molars and premolars placed closer together than the posterior pair; this character serves to distinguish the present species from *O. uintanus*, the closest allied form, (3) m_3 robust and with short stout heel, (4) well developed cingulum.

Measurements of Type.

	mm.
p_3–m_3	33.
m_{1-3}	26.
m_1 antero-post. diam.	7.3
" transv. "	5.6
m_3 antero-post. diam.	10.5
" transv. "	5.
p_4 transv. "	5.2
Depth of ramus at m_2	13.

In an important specimen (Amer. Mus. Coll., No. 12649) of this species from Sage Creek Spring, Hor. C., collected by Mr. P. C. Miller, the upper and lower teeth are found associated.

The characters of the upper teeth are: (1) Molars not compressed antero-posteriorly but m^3 shows strong compression at the postero-external angle, giving the tooth a sheared off appearance as in *Systemodon* and *Hyrachyus*, (2) parastyle moderately developed, weakest on m^3, (3) mesostyle moderately developed on molars, strongest on m^3, (4) metaconule not well separated in last molar, (5) p^3 and p^4 fully molariform quadrate teeth.

---

[1] The third premolar is not present in the type, but in an associated specimen (No. 12649) in the American Museum Collection.

Measurements of No. 12649.

	mm.		mm.
p^3–m^3	41.	p_3–m_3	42.3
m^{1-3}	24.	m_{1-3}	27.2
p^4 antero-post. diam	7.5	m_1 antero-post. diam	8.2
" transv. "	9.2	" transv. "	6.
m^1 antero-post. "	8.4	m_3 antero-post. "	10.5
m^3 transv. "	10.6	" transv. "	5.6
m^3 antero-post. "	8.		
" transv. "	10.6		

Distinctions between this species and *O. uintanus* are found: (1) In the shorter, broader third molar, (2) the placing closer together of the anterior pair of cusps of both the molars and the premolars, (3) the comparatively stronger entoconid on the third premolar.

(20.) **Orohippus (Aminippus) uintanus** *Marsh.*

Syn.: *Orotherium uintanum* Marsh.

Type locality: Henry's Fork, Upper Beds, Bridger Basin, Wyo. *Type specimen:* A lower jaw with p_2–m_3 r., in fine state of preservation (Yale Mus. Coll.).

Characters of type: (1) No diastema between p_1 and p_2, (2) p_3 with comparatively weak entoconid, (3) anterior pair of cusps on the molars as wide apart as the posterior pair, (4) m_3 very slender with long narrow heel.

Measurements of Type.

	mm.		mm.
p_2–m_3	47.	p_4 antero-post. diam	7.
m_{1-3}	26.5	" transv. "	5.
m_3 antero-post. diam	11.5	Depth of ramus m_2	16.
" transv. "	5.		

Prof. Marsh made this the type of the genus *Orotherium,* distinguished from the European *Lophiotherium* by a posterior tubercle on p_2 and by the twinned condition of the antero-internal cusp of the molars, and transferred the species *L. sylvaticum* and *L. ballardi* to this genus. He did not, however, make any distinction between *Orotherium* and *Orohippus,* the type of the latter consisting of upper teeth only.

The species is distinguished from *O. sylvaticus* by the slenderness of the m_3, by the wider separation of the anterior pair of cusps on the molars, and by the comparatively weaker entoconid on the third premolar. With *O. agilis*, the third member of the subgenus, comparison's cannot be made since there are no specimens of either species with upper and lower teeth in association. These two species agree in size, however, and it is possible they may belong to the same form.

(21.) **Orohippus (Aminippus) agilis** *Marsh.*

Type locality: Henry's Fork,[1] Upper beds, Bridger Basin, Wyo. *Type specimen:* Anterior portion of skull, nearly complete fore limb, and several vertebræ. (Yale Mus. Coll., No. 1268.)

Characters of type: (1) Parastyle rudimentary, (2) mesostyle weak, strongest on m^2, (3) p^3 and p^4 fully molariform quadrate teeth, (4) p^2 with well developed internal cusp, (5) no diastema between p^1 and p^2, (6) canine large.

Measurements of Type.

			mm.
Length of mc II	51.	p^1–m^3 (approx.)	49.
" " " III	55.5	m^{1-3}	23.
" " " IV	49.	m^1 antero-post. diam.	8.
" " " V	40.	" transv. "	9.5
		p^4 antero-post. "	7.2
		Antero-post. diam. of canine alveolus	7.2

Separable from *O. sylvaticus* Leidy by the weaker parastyle and mesostyle and probably by the more quadrate outline of the last molar. In the type of *O. agilis* only the root of this tooth is preserved but it indicates a tooth of rather different shape from that of *O. sylvaticus.*

UINTA STAGE.

Epihippus *Marsh.*

Characters: (1) Third and fourth upper premolars molariform, (2) mesostyle fully developed, (3) external cusps of upper molars crescentic, (4) second upper premolar with prominent postero-internal and small antero-internal cusp, (5) no diastema, (6) third and fourth lower premolars molariform, (7) second lower premolar with one anterior and two posterior cusps, (8) no diastema.

---

[1] There is no definite locality given for this type in Prof. Marsh's records but Mr. J. Heisey, one of Marsh's collectors in the Bridger, has informed me that it was collected on Henry's Fork and is therefore from the upper beds. The advanced condition of the premolars, as well as the nature of the matrix in which the specimen was imbedded, would seem to bear out this statement.

(25.) **Epihippus gracilis** *Marsh.*

Syn.: *Anchitherium gracilis* Marsh.
(26) *Orohippus uintensis* Marsh.

Type locality: White River, Uinta Basin, Utah. *Type specimen:* Lower jaws with dp_{2-4}, m_{1-2} l.; dp_{3-4}, m_1 r (Yale Mus. Coll.).

Characters of type: (1) Crowns of molars high, (2) m_1 and m_2 of about equal antero-posterior and transverse diameters, (3) antero-internal cusp strongly bifid, (4) cingulum rather weak but continuous.

Measurements of Type.

	mm.
m_1-_2	16.5
m_1 antero-post. diam.	8.
" transv. "	6.

E. (*Orohippus*) *uintensis* Marsh: I am unable to distinguish between this species and *E. gracilis.* The type is from the same locality and horizon as *E. gracilis* and consists of jaw fragments with p_2–m_1 l, m_2 r, m^{1-2} r. The first and second lower molars agree so closely with those of *E. gracilis* that the differences may be due entirely to individual variations and to age.

The characters of E. uintensis are (1) Parastyle moderate, (2) mesostyle large and massive, not compressed antero-posteriorly, (3) metaconule distinct, (4) p_3 with four nearly equal cusps, (5) p_2 with one anterior and two posterior cusps and strong oblique crest, (6) p single rooted, (7) p_{3-4} with antero-internal cusps bifid.

Measurements of type of E. uintensis.

	mm.
p_1–m_3 (approx.)	60.
m_1-_3	31.
m_1 antero-post. diam.	9.
" transv. "	6.5
m_1-_2	18.
m_2 antero-post. diam.	9.
" transv. "	12.

Referred specimens: No. 2042 (Amer. Mus. Coll.) is a young individual with milk teeth and first and second true lower molars. These are similar in structure to those of *E. gracilis* and *E. uintensis,* and are intermediate in size between the two types.

Epihippus parvus sp. nov.

Type locality: White River, Hor. C., Uinta Basin, Utah. *Type speci-*

men: Both upper and both lower jaws and fragments of the skeleton (Am. Mus. Coll., No. 2038, Coll. by Exp. of 1895).

Characters of type: (1) Parastyle very prominent, (2) mesostyle complete and compressed antero-posteriorly into a sharp ridge, (3) p^3 and p^4 similar to molars, (4) p^2 with a strong postero-internal cusp and an incipient cusp at the antero-internal angle of the tooth, (5) m_3 with a very much reduced heel.

Measurements of Type.

	mm.		mm.
p^1–m^3 (approx.)	42.	p_3–m_3	36.
m^{1-3}	20.	m_{1-3} (approx.)	23.5
m^1 antero-post. diam.	7.	m_3 antero-post. diam.	9.
" transv. "	9.	" transv. "	4.5
m^3 antero-post. "	6.5	p_4 antero-post. "	6.3
" transv. "	9.	" transv. "	4.3
p^4 antero-post. "	5.5		
" transv. "	7.8		

The distinguishing characters are the small size, the great development of parastyle and the compressed mesostyle.

Referred specimens: No. 2066 (Am. Mus. Coll.) comprising an upper and lower jaw, apparently represents a large variety of this species. It is intermediate in size between *E. gracilis* and *E. parvus* but has the characters of mesostyle and parastyle found in the latter.

STATUS OF GENERA AND SPECIES AS HERE TREATED, IN CHRONOLOGICAL ORDER IN THEIR RESPECTIVE HORIZONS.

Eohippus (Wasatch)
- *index* Cope.
- *angustidens* Cope, includes *cuspidatus* Cope.
- *cristonensis* Cope, includes *loevii* Cope.
- *validus* Marsh.
- *etsagicus* Cope.
- *cristatus* Wortman.
- *montanus* Wortman.
- *resartus* sp. nov.
- *borealis* sp. nov.

Indet. types.
- *vasacciense* Cope
- *tapirinum* Cope
- *pernix* Marsh

(Wind River)
- *craspedatus* Cope.
- *venticolus* Cope.

Orohippus (Bridger)	*pumilus* (*Lophiodon*) Marsh, includes *procyoninus* Cope.	
	ballardi Marsh, includes *cinctus* Cope.	
	typicus nom. nov. (to replace *O. pumilus* Marsh, preoccupied).	
	major Marsh.	
	osbornianus Cope.	
	atavus sp. nov.	
	progressus sp. nov.	
	sylvaticus Leidy.	Subgenus *Aminippus* nom. nov. (to replace *Orotherium* Marsh, preoccupied).
	uintanus Marsh.	
	agilis Marsh.	
Epihippus (Uinta)	*gracilis* Marsh, includes *uintensis* Marsh.	
	parvus sp. nov.	

Observations on Premolar Development.

One of the progressive characters of the Eocene Horses is the gradual molarization of the second, third and fourth premolars in both the upper and lower jaws. Dr. Wortman discusses in his paper on the Wasatch and Wind River Hyracotheres[1] the premolar evolution in the American horses and takes issue with Prof. W. B. Scott as to the method by which the quadritubercular condition of the third and fourth upper premolars of the Upper Eocene Hyracotheres has been brought about from the tritubercular condition of these teeth in the Lower Eocene forms.

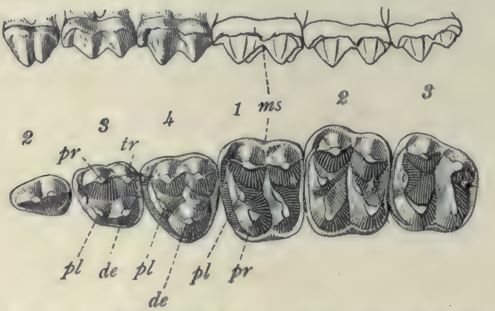


Fig. 3. *Eohippus venticolus.* Upper teeth, side and crown views. × $\frac{4}{3}$. (After Wortman.)

Prof. Scott states in his article on the evolution of the mammalian premolar teeth[2] that the fourth cusp is added, in the fourth premolar at least, always at the postero-internal angle of that tooth. Dr. Wortman's studies of the Hyracotheres, however, led him to conclude that in this group the process of development has been different, and he says: "In the horse series of America, however, the addition of this fourth main element to the crowns of the superior premolars has pursued an entirely different course, and instead of appearing at the postero-internal angle of the crown *it has been added at the antero-internal angle.* The proof of this assertion is to be seen in the third and fourth superior molars of *Hyracotherium index* and *Protorohippus venticolus.*"

---

[1] *Loc. cit.*, p. 106.
[2] Proc. Acad. Nat. Sci. Phil., 1892, p. 414.

My own conclusions, based upon much more extensive material than Dr. Wortman had, especially from the important Bridger stage, are that in the fourth premolar this fourth cusp has been added, as Prof. Scott states, at the *postero-internal angle,* while in the third premolar it has been added at the *antero-internal* angle. The mode of development is, therefore, different in the two teeth, a fact which may account for the advancement of the third over the fourth premolar in the process of development as shown in some Wind River horses. Apparently Dr. Wortman's error was due to

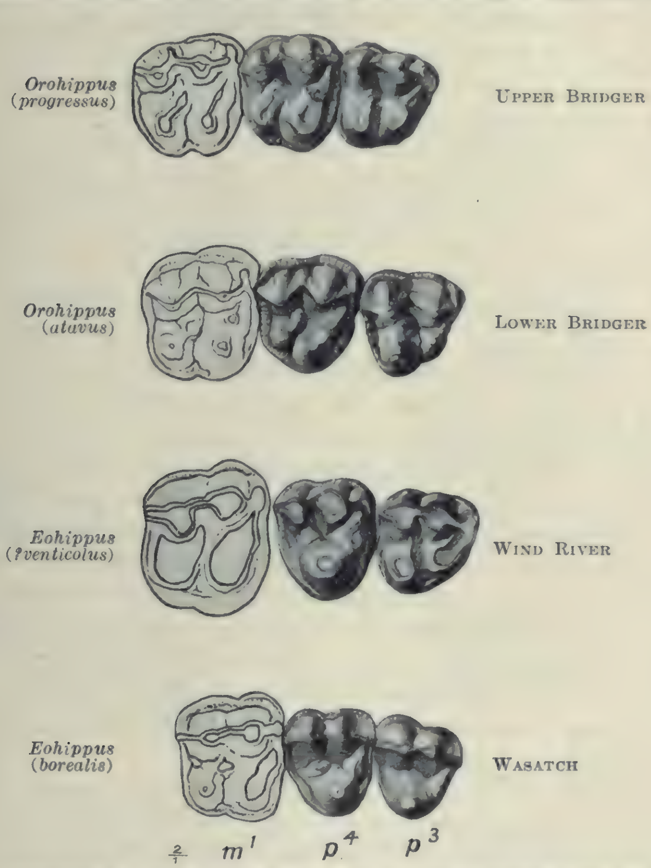

Orohippus (*progressus*)
UPPER BRIDGER
Orohippus (*atavus*)
LOWER BRIDGER
Eohippus (*?venticolus*)
WIND RIVER
Eohippus (*borealis*)
WASATCH
2/1
m1
p4
p3

Fig. 4. Four stages of Eocene Horses, to show development of internal cusps on the upper premolars.

the fact that he did not have a fourth premolar of *Orohippus* for comparison, and in assuming that the method of development was the same in the fourth as in the third premolar. In *Eohippus venticolus* there are in the fourth premolar three principal cusps, two external and one internal, also two smaller cusps occupying the position of intermediates. The anterior one of these latter, the protoconule, Wortman believes to be the cusp which is destined to become, in *Orohippus*, the fourth principal cusp, corresponding in position with the protocone of the molars. This is not the case, however, as is shown in the figures; the protoconule remains as an intermediate cusp and it is the posterior intermediate which is eventually shifted inward and becomes the fourth main cusp, analogous with the hypocone.

Another progressive character in the Equidæ is seen in the gradual shifting forward of the point of greatest transverse width in both the upper and lower series of teeth. This is especially well shown in the lower teeth, where the point of maximum width is shifted from the last molar, in certain species of the Wasatch genus *Eohippus*, to the third premolar in individuals of the modern *Equus*. The series of outline drawings, made from careful measurements, shows the condition as found in various genera in the successive geological horizons. The specimens selected for these outlines have been chosen for the purpose of best illustrating the point, and the character as indicated in the drawing is not always constant in that genus, but there is no very great variation to be found within generic limits or even between different genera from the same formation. The characters exhibited by genera in various formations in which horses occur are as follows:

WASATCH.— In a few specimens of *Eohippus*, including the type of *E. cristonensis*, the third molar is the widest tooth of the series. In the majority of cases, though, it is the second molar which has the greatest width.

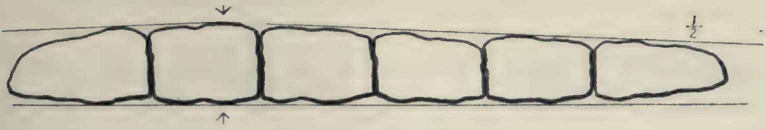
WIND RIVER.— *Eohippus venticolus* is similar to most of the Wasatch forms in that the second molar is the widest, but it shows an advancement in the relatively wider premolars.

BRIDGER.— *Orohippus uintanus* has the first and second molars of about equal size. It shows progression over the Wind River forms in the reduced third molar and in the further increase in width of the premolars.

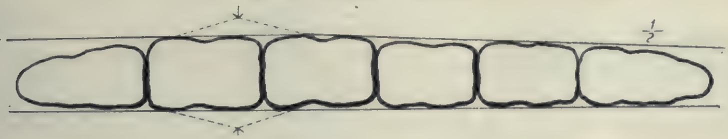
UINTA.— In *Epihippus* the first molar is usually slightly wider than the second, a condition not found in any Bridger horses.

OLIGOCENE.— In the genus *Mesohippus* the fourth premolar is quite uniformly the widest tooth of the series and there is a marked reduction of the molars.

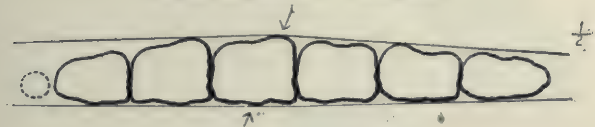
MIOCENE.— *Hypohippus* and other Miocene genera show an advance over Oligocene forms in reduction of molars and in having the third and fourth premolars of nearly equal width.



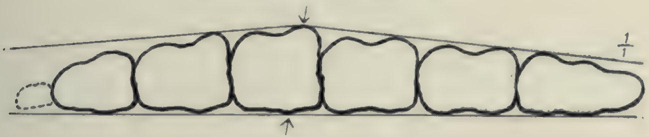
Equus caballus. Recent.



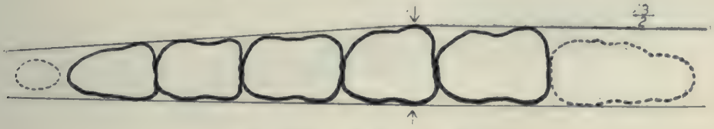
Equus complicatus. Pleistocene.



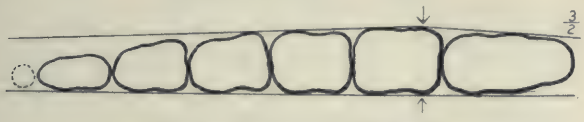
Hypohippus sp. Loup Fork.



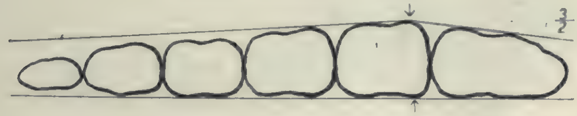
Mesohippus sp. White River.



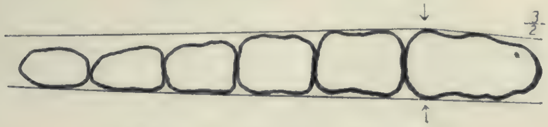
Epihippus uintensis. Uinta.



Orohippus uintanus. Bridger.



Eohippus venticolus. Wind River.

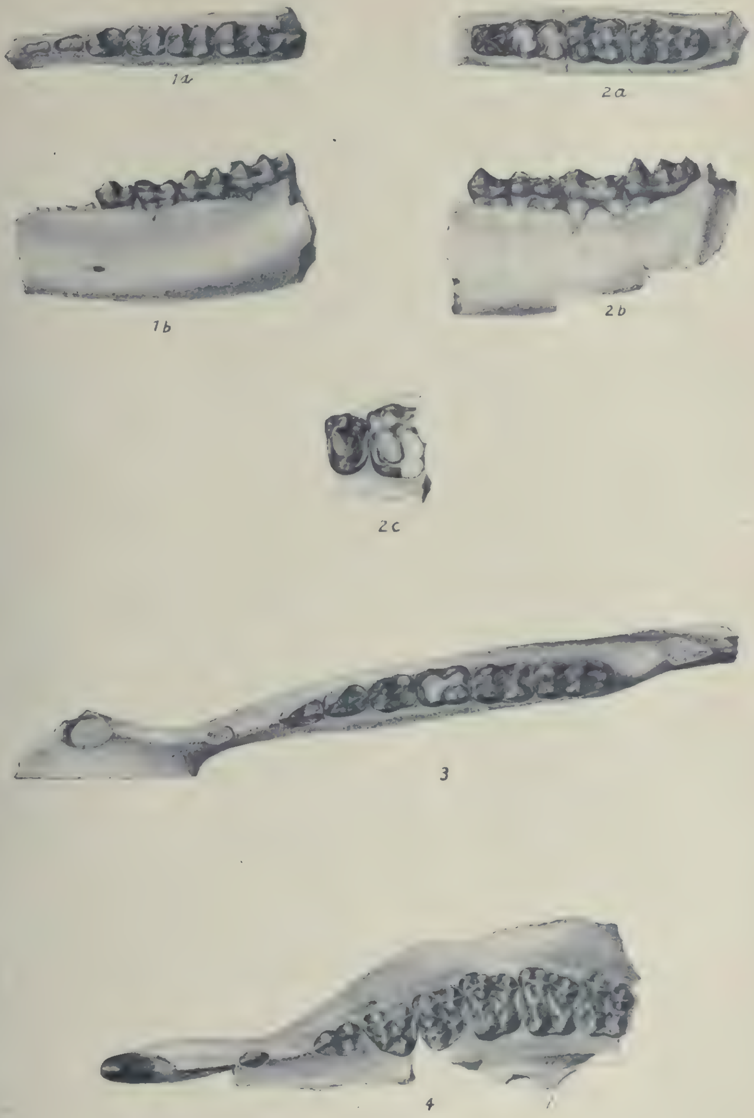


Eohippus cristonensis. Wasatch.

Fig. 5. Accurate outlines of lower cheek teeth of Equidæ. Arrows indicate point of greatest transverse diameter in each series, ranging from the third molar in the Wasatch species to the third premolar in the modern *Equus*.

PLEISTOCENE.— In nearly all specimens of Pleistocene horses the third and fourth premolars are the broadest of the series and of nearly equal width.

RECENT.— There is an occasional specimen of the modern *Equus* in which the third premolar is the widest tooth of the series, a condition not observed in any of the Pleistocene species. The second premolar is relatively larger than in any fossil forms examined.



Wasatch and Lower Bridger Horses.

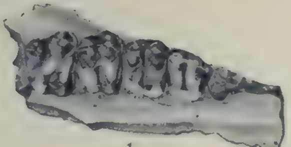
All figures natural size.

Fig. 1. *Eohippus index* Cope. Type. Amer. Mus. Coll. *a*, crown view, *b*, outer view of lower jaw.

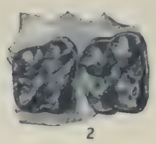
Fig. 2. *Eohippus validus* Marsh. Type. Yale Mus. Coll. *a*, crown view and *b*, outer view of lower jaw; *c*, crown view of fourth upper premolar and first molar.

Fig. 3. *Eohippus borealis* Granger. Type. Amer. Mus. Coll.

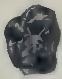
Fig. 4. *Orohippus atavus* Granger. Type. Amer. Mus. Coll.



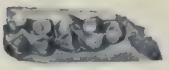
1



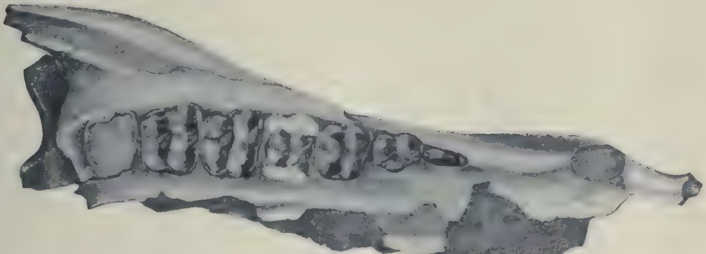
2



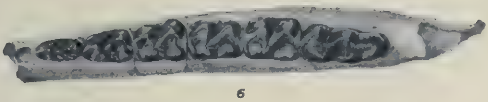
3



4



5

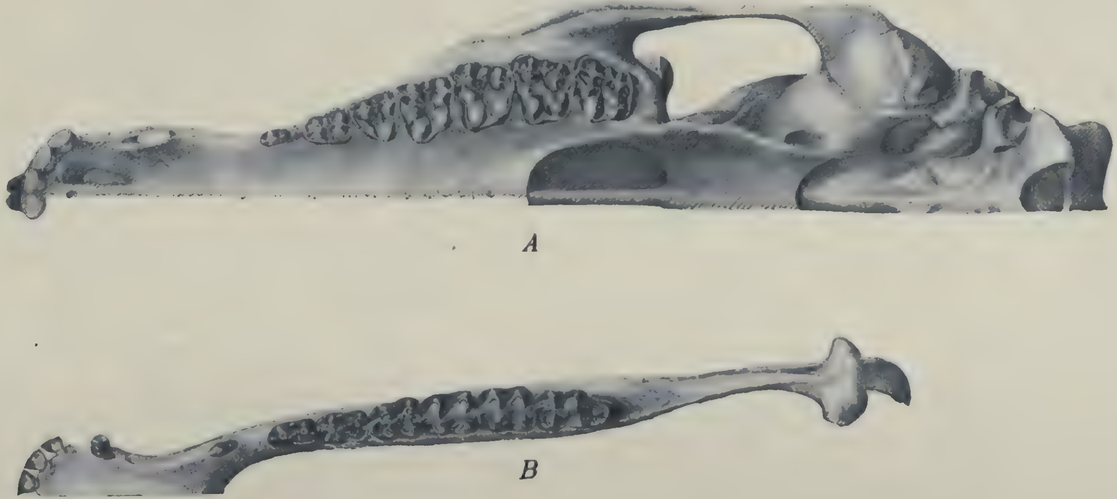


6

BRIDGER HORSES.

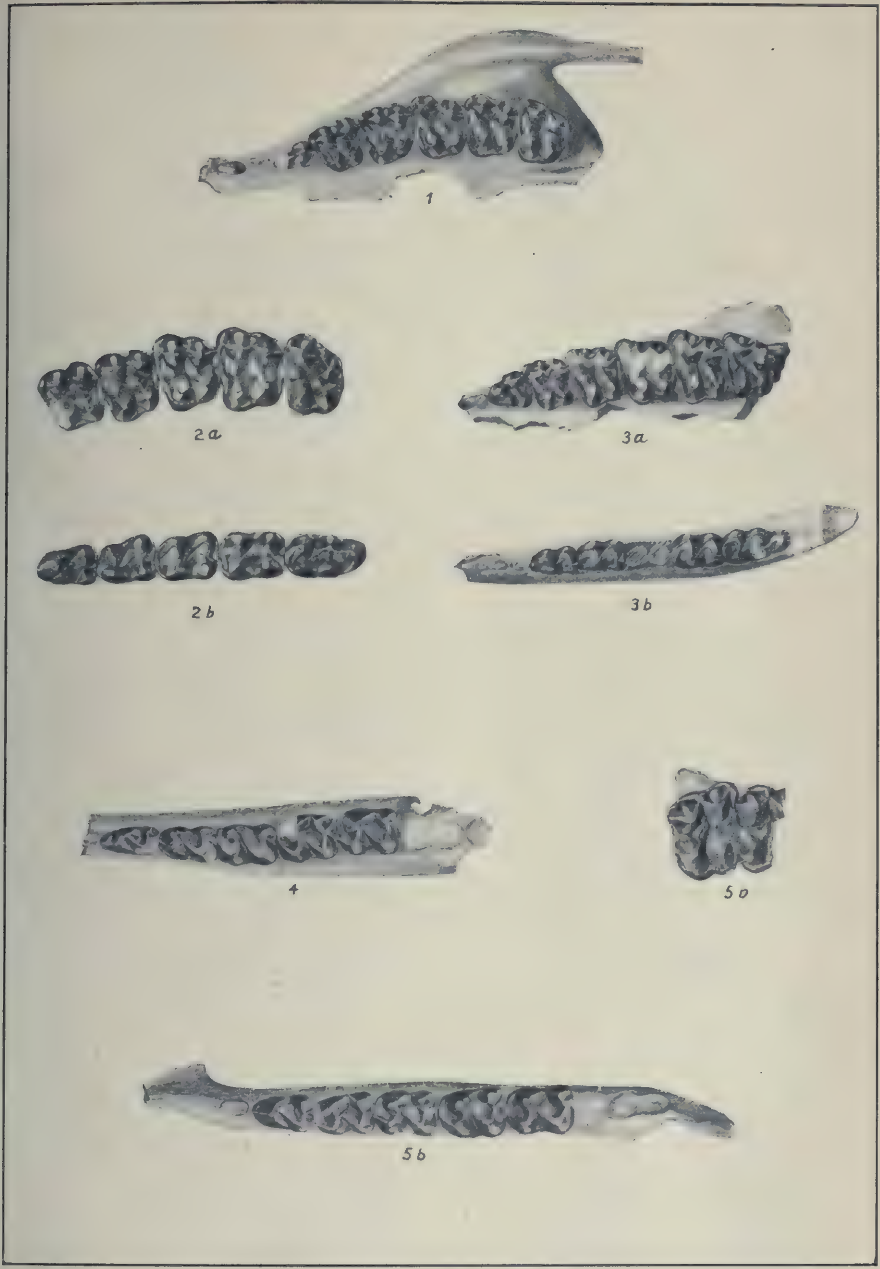
All figures natural size.

Fig. 1. *Orohippus* (*Lophiodon*) *pumilus* Marsh. Type. Yale Mus. Coll.
Fig. 2. *Orohippus major* Marsh. Type. Yale Mus. Coll.
Fig. 3. *Orohippus typicus* Marsh. Type. Yale Mus. Coll. Third upper molar, right..
Fig. 4. *Orohippus ballardi* Marsh. Type. Yale Mus. Coll.
Fig. 5. *Orohippus agilis* Marsh. Type. Yale Mus. Coll.
Fig. 6. *Orohippus uintanus* Marsh. Type. Yale Mus. Coll.



Bridger Horses.

Orohippus osbornianus Cope. Amer. Mus. Coll. No. 12648. *A*. skull. *B*. lower jaw. Nat. size.



UPPER BRIDGER AND UINTA HORSES.

All figures natural size.

Fig. 1. *Orohippus progressus* Granger. Type. Amer. Mus. Coll.

Fig. 2. *Orohippus sylvaticus* Leidy. Amer. Mus. Coll. No. 12649. *a*, upper teeth, *b*, lower teeth.

Fig. 3. *Epihippus parvus* Granger. Type. Amer. Mus. Coll. *a*, upper teeth, *b*, lower teeth.

Fig. 4. *Epihippus gracilis* Marsh. Type. Yale Mus. Coll.

Fig. 5. *Epihippus uintensis* Marsh. Type. Yale Mus. Coll. *a* first and second upper molars of right side, *b*, lower jaw.

56.9(1181:62)

Article XVI.— NEW FOSSIL MAMMALS FROM THE FAYÛM OLIGOCENE, EGYPT.

By Henry Fairfield Osborn.

Through the generosity of President Morris K. Jesup the Museum was enabled to send a party into the Fayûm region of northern Egypt in the winter of 1906–1907 under the direction of the writer. Capt. H. G. Lyons, Director of the Geological Survey, coöperated with the plans of the party most heartily, facilitated the work of outfitting, and especially extended the privilege of excavation in the quarries located by Messrs. Beadnell and Andrews. Mr. Hartley T. Ferrar of the Survey was detailed to accompany the writer on a three weeks' reconnoissance of the famous fossil bearing region, with the object of determining the horizons and visiting the principal localities where discoveries had been made. Mr. Walter Granger, assisted by Mr. George Olsen, both of the American Museum of Natural History staff, remained in charge until June 14, and displayed energy and skill in the work of collection. Herr Richard Markgraf, who had already had considerable experience in this work in the Fayûm in the service of Professor Eberhard Fraas of Stuttgart, and others, joined the party and rendered valuable aid. The Museum is also indebted to Mr. Hugh J. L. Beadnell, formerly of the Survey, to Mr. Charles W. Andrews of the British Museum, and to Professor Fraas for valuable advice given by letter. Our most grateful acknowledgments are due to Director Lyons, also to Messrs. H. T. Ferrar, W. F. Hume and A. Lucas of the staff of the Geological Survey for the cordial coöperation which materially contributed to the successful results which were obtained.

The present paper is a preliminary notice of the results obtained.

Our collection numbers about 550 specimens, as catalogued by Mr. Granger, including more or less complete remains of most of the fossil forms so far known to be characteristic of this region. A number of new forms related to those already described by Andrews were discovered.

The hope that exceptionally careful methods of search might result in a substantial addition to the Fayûm fauna was realized by the discovery of three of the smaller kinds of mammals which had hitherto escaped the eyes of collectors, representing especially the Rodentia and members of two other mammalian orders which are not determinable at present.

Another important result was the finding of additional fossils on the high-level fossil-bearing stratum in the upper or Fluvio-Marine Beds. It was in these beds that two of the new forms were found. These beds were regarded as Upper Eocene by Andrews, but are considered of Oligocene age by Stromer (1907).

This brief preliminary description will be followed by a fuller narrative and exposition of the chief results of our work.

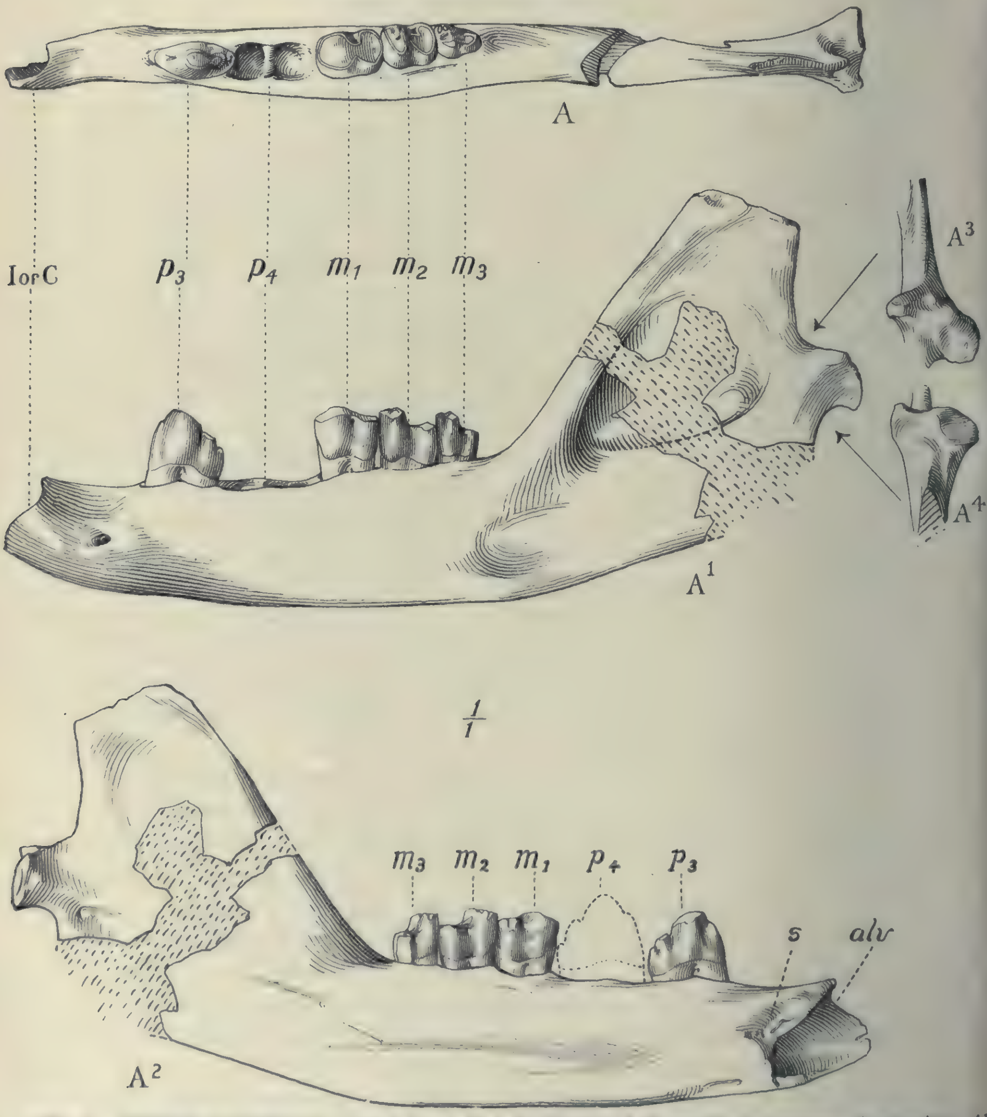


Fig. 1. *Ptolemaia lyonsi* Osborn. Type, Amer. Mus. No. 13269. Left mandibular ramus. *A*, superior; *A*^{1}, external: *A*^{2}, internal; *A*^{3}, superior view of condyle and coronoid process; *A*^{4}, posterior view of same. All $\frac{1}{1}$.

OF UNCERTAIN ORDINAL POSITION.

PTOLEMAÏIDÆ fam. nov.

Ptolemaïa lyonsi gen. et. sp. nov.

This problematic form is named after the famous Greek family which ruled the region. The specific name is given in honor of Director Lyons of the Survey.

The type specimen is the left ramus of a lower jaw (Amer. Mus. No. 13269) which was found in the smaller of the two main quarries previously worked by the Survey, which we shall designate as Quarry A.

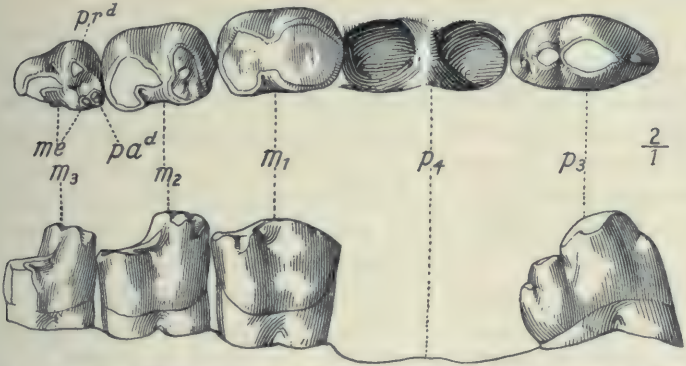


Fig. 2. *Ptolemaïa lyonsi* Osborn. Type, Amer. Mus. No. 13269. Superior and internal view of inferior teeth. $\frac{2}{1}$.

Characters.— I or C1, P2, M3. The large anterior tooth, either an incisor or a canine, probably the latter, was laterally compressed, with its closed fang closely approximated to the symphysis. The alveolus is followed by a wide diastema in which no traces of the first or second premolars remain.

The third premolar is laterally compressed, with two fangs and a high crown, backwardly directed and supporting a single main cone, a smaller posterior cone, and anterior and posterior basal cuspules. The fourth premolar (missing in this specimen) was evidently a much larger tooth but probably of the same general form as the third.

There are no cingula on either the premolars or molars.

The three true molars are also bifanged, and decrease regularly in size posteriorly. The enamel is well developed. The crowns of m_1 and m_2 are considerably worn; that of m_3 exhibits the coronal pattern, which consists of an elevated trigonid supporting three cusps, an external protoconid, and two internal and closely compressed cusps (para- and metaconids); the talonid is more depressed and probably supported an inner and an outer cusp (entoconid and hypoconid). Lateral vertical grooves on the sides of the crowns separate the trigonid from the talonid in each of these teeth.

The ramus is long and shallow. The mental foramen is anteriorly placed below the diastema. The coronoid process is relatively large. The condyle is extended transversely and expanded on the inner side.

Affinities.— This evidently represents a new family of mammals, to which the name **Ptolemaïidæ** may be given. It possibly represents a new order of mammals which will be defined by the writer if additional materials are found. It is obviously not a primate. The large size of the coronoid, depressed position of the condyle, subtrenchant characters of the premolars, enlarged cutting teeth and tuberculo-sectorial molar teeth, relate it rather to the unguiculate than to the ungulate division of placentals. The elevated trigonid and depressed talonid belong to a primitive stage characteristic of insectivores and creodonts; the dentition does not resemble, however, that of any known form of Unguiculate, either Insectivore, Carnivore, Creodont, or Edentate. The laterally compressed premolars with cuspules all in the same line suggest those of the Pinnipedia; but the dental formula is entirely different from that of the Pinnipedia. Certain Creodonts have a series of homologous cusps on the premolar teeth but in these carnivores the main cusp exhibits a piercing character which is lacking in this type.

While the anterior teeth of *Ptolemaïa* may have been adapted to the prehension of an active prey, the premolar and molar teeth are not in the least of a carnivorous or sectorial character. In fact it is difficult to surmise the adaptation of these teeth.

Thus with our knowledge limited to this imperfect type specimen we cannot offer any reasonable suggestion either as to the habits or affinities of *Ptolemaïa.*

RODENTIA.

? Suborder MYOMORPHA.

Fam. EOMYIDÆ.

The discovery in the Upper or Fluvio-Marine beds (Oligocene) of the diminutive jaws and teeth of rodents was a most welcome one. The affinities are apparently with certain Lower Oligocene rodents of Europe which have been provisionally referred to the Myomorpha. Two distinct generic types were found, namely: *Phiomys*, in the lower fossiliferous level, Quarries A, and B, of the Fluvio-Marine Beds; *Metaphiomys*, in the upper or higher fossiliferous level, of the Fluvio-Marine Beds.

Phiomys andrewsi gen. et sp. nov.

The type is the right ramus of a lower jaw (Amer. Mus. No. 13275) containing a fourth premolar and three molars, and the paratypes are three other jaws, No. 13274 adult, Nos. 13271, 13272 juvenile. The generic name is after 'Phiom' the Greek designation of the Fayûm. The specific name is in honor of Charles William Andrews, the monographer of the Fayûm fauna.

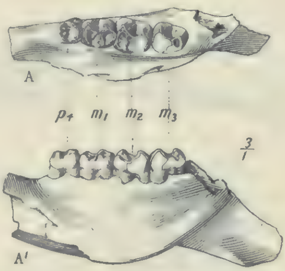


Fig. 3. *Phiomys andrewsi* Osborn. Type, Amer. Mus. No. 13275. Portion of right mandibular ramus. $\frac{3}{1}$.

In the type the crowns of the grinding teeth are well preserved. The molars are brachyodont. The fundamental pattern consists of four tubercles (apparently the protoconid, metaconid, hypoconid, entoconid) with a fifth posterior median tubercle (hypoconulid); transverse crests and spurs form backwardly opening crescents connecting these tubercles; a delicate median spur extends into the main valley between the metaconid and entoconid, as clearly shown in the enlarged drawing, Fig. 3. The fourth premolar is a rounded tooth, with an incipient molariform pattern. In the juvenile paratypes (Nos. 13271, 13272), dp_4 is preserved as a relatively elongate or narrow tooth.

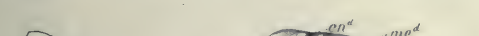


Fig. 4. *Phiomys andrewsi* Osborn. Paratype, Amer. Mus. No. 13271. Portion of right mandibular ramus. $\frac{3}{1}$. First molar, $\frac{6}{1}$

The resemblances of these teeth are closest with the rodents described as *Eomys zitteli* by Schlosser from the Phosphorites of Mouillac. This resemblance is broadly sustained by the structure of the jaw, as figured by Schlosser and Zittel (Handbuch der Palæontologie, Band IV, p. 527, Fig. 439 A & B). Both of these genera were placed by

Schlosser (Die Näger des Europäischen tertiärs, Palæontographica, Band 31, 1884, pp. 84–90, Tafel 8, Figs. 17, 24) in the Myomorpha.

The resemblances to Myomorpha of the Phosphorites of Europe are consistent with the presence in the Fayûm, found in the same quarries with the Rodents, of hyænodonts belonging to the genera *Pterodon* and *Apterodon*, which are both characteristic of the Lower Oligocene of France. There is thus little doubt that we have here remains of a rodent family common to northern Africa and central France at this period.

The jaw (Amer. Mus. No. 13271) exhibits a strong masseteric crest rising obliquely beneath the grinding teeth. This jaw contains dp_4. The pattern of the molar teeth is similar to that of the molars in the type and is very perfectly displayed (Fig. 4) as consisting of two transverse crests with subcrescentic disposition.

Comparison.— The fourth premolar of *Phiomys* is simpler than that of *Eomys*, and the molars are more elongate. In *Eomys* the molars are antero-posteriorly compressed and subquadrate in contour, and the fourth premolar contains two distinct transverse lobes.

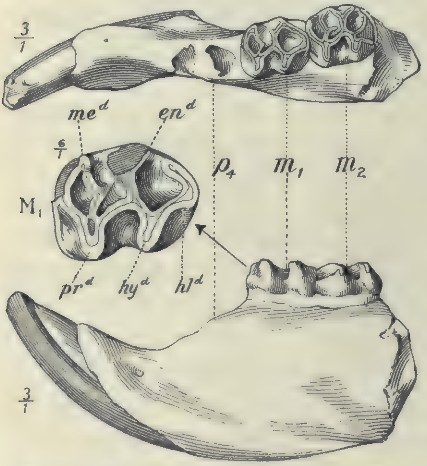


Fig. 5. *Metaphiomys beadnelli* Osborn. Type, Amer. Mus. No. 13273. Portion of left mandibular ramus, $\frac{3}{1}$. First inferior molar, $\frac{6}{1}$.

Metaphiomys beadnelli gen. et sp. nov.

The type of this species (Amer. Mus. No. 13273) was found on the *upper* level of the Fluvio-Marine beds, on the bench above quarries A and B, in which the types of *Phiomys andrewsi* were obtained, and about 200 feet below the basalt layer. The specific name is in honor of Hugh J. L. Beadnell, geologist, who first explored this region for the Survey.

The molar teeth are of fundamentally similar pattern to those of *Phiomys* but of very much more progressive and complex character, suggesting rather those of *Sciuroides quercyi* and of some species of *Cricetodon* figured by Schlosser. The surface of the crown is elaborately crested and cupped, whereas in *Phiomys* it is rather disposed into two transverse ridges with low connecting crests, as in the typical Myomorpha.

As best seen in m_1, there are four main tubercles and a posterior median tubercle (protoconid, metaconid, hypoconid, entoconid, hypoconulid) all connected by crests. A median spur also extends into the median valley between the metaconid and entoconid, and the crest connecting the hypoconid and entoconid bifurcates on the inner side, giving the crown a very complex pattern, which is intensified by the crest connecting the entoconid, hypoconulid, and hypoconid.

OF UNCERTAIN ORDINAL AND FAMILY POSITION.

Apidium phiomensis gen. et sp. nov.

The type (Fig. 6) is the middle portion of the ramus of a left lower jaw (Amer. Mus. No. 13370) containing the fourth premolar and three true molars. It was found on the *upper* levels of the Fluvio-Marine beds. The fanciful name *Apidium* is in reference to the sacred bulls of Apis.

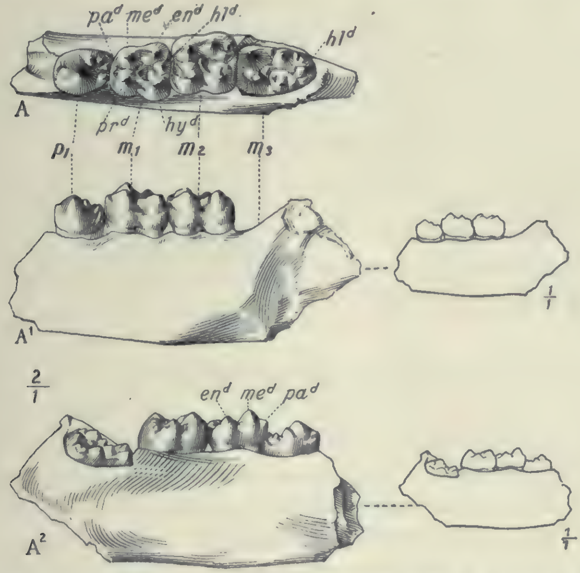


Fig. 6. *Apidium phiomensis* Osborn. Type, Amer. Mus. No. 13370. Portion of left mandibular ramus. *A*, superior; *A*^{1}, external; *A*^{2}, internal. Shaded figures, $\frac{2}{1}$; outline figures, $\frac{1}{1}$.

Characters.— The size is inferior to that of *Acotherulum saturninum*, and the characters of the teeth are quite distinct generically. The molars are essentially low-crowned, or brachyodont, with the cuspules in opposite pairs, and the trigonids and talonids are on the same level and multicuspidate, that is, with numerous supplementary cusps. The fourth premolar is a suboval tooth with large anterior cone bearing anterior and posterior accessory cusps on its inner surface and a depressed talonid region bearing three or four accessory cuspules. The first molar exhibits five main cusps (protoconid, metaconid, hypoconid, entoconid, hypoconulid) and a vestigial paraconid. There is also a small cusp directly in the center of the crown, a very unusual feature. The second molar is a somewhat larger tooth with similar characters except that the paraconid is entirely wanting. The third molar is elongate with the four main cusps surrounding the central cusp and with a posterior extension of the heel, or hypoconulid, reinforced by a number of accessory cuspules.

The generic name, *Apidium*, does not imply any indication of the affinities of this animal to the Artiodactyla, or even to the Suoidea. Comparisons are suggested with certain species of the Upper Eocene *Cebochœrus* and *Acotherulum*, but this animal is of more diminutive size. It was evidently a small omnivorous or frugivorous form with partly cuspidate teeth. It might be placed near *Acotherulum* among the diminutive bunodont Artiodactyla except for the rounded form of p_4, a tooth which in the Artiodactyla generally is laterally compressed. Comparisons with *Cebochœrus* show equally wide differences. Reference to the primates is equally uncertain because the teeth do not agree with those of any Eocene or Oligocene primate known. Until the anterior teeth are discovered we must remain in the dark as to the affinities of this animal.

FAUNA OF THE UPPER LEVEL.

The mammals collected on the *upper* fossiliferous level are provisionally determined as follows:

Arsinoitherium sp. indet.
Metaphiomys beadnelli.
Apidium phiomensis.
Apterodon macrognathus.
Ancodon gorringei.
Ancodon (?) *minus.*
? *Geniohyus.*
Megalohyrax eocænus.

56.57, 72P(1182:78.8)

Article XVII.— TWO FOSSIL PHORIDÆ FROM THE MIOCENE SHALES OF FLORISSANT, COLORADO.

BY CHARLES T. BRUES.

The occurrence of Diptera belonging to the family Phoridæ in the fossil state has been recorded a number of times by various European workers, but hitherto none has been described from the American continent. Two species recently collected by Professor and Mrs. T. D. A. Cockerell at Florissant, Colorado, are therefore of considerable interest, and it is with great pleasure that I avail myself of Professor Cockerell's kind permission to describe them and point out their relationship to living forms.

In 1845 Berendt [1] noted the presence of Phora (*sensu lato*) in Baltic amber and five years later Loew at the close of his valuable paper on amber and its fauna [2] mentions that he has distinguished eleven species, none of which differ remarkably from the recent European members of the family. Unfortunately these were not described by him. More recently Helm includes the family in his enumeration of the amber fauna,[3] but likewise without any more detailed references.

The first attempts to specifically describe any fossil Phoridæ are quite recent, and have been made by Meunier, who has carefully figured some species found in copal.[4]

Two of these, *Phora copalina*, and *P. ethiopica* undoubtedly belong to the genus *Aphiochæta* which is at the present time the most abundant genus of the family, both in species and individuals in all parts of the World. Neither seem to differ in any remarkable way from recent forms, except for the strong tibial cilia of the second species, which are, however, duplicated in a very few recent species not generically distinct from *Aphiochæta*.

A third species described by Meunier [5] from recent Madagascar copal is referred to *Phora*, but it also very probably belongs to *Aphiochæta*, to judge from the general type of wing venation, shortened costal vein, etc.

The present fossils from Florissant are referable to the recent genus

---

[1] Organische Reste im Bernstein. Vol. I, p. 57 (1845), Berlin.

[2] Ueber den Bernstein und die Bernsteinfauna. Progr. königl. Realsch. Meseritz, 1850, pp. 1–44.

[3] Beiträge zur Kenntniss der Insecten des Bernsteins. Schrift. Naturf. Gesellsch. Danzig, IX, pp. 220–231 (1896).

[4] Meunier, F. Nouvelles Recherches sur quelques Diptères et Hyménoptères du Copal Fossile, "Dit de Zanzibar." Rev. Sci. Bourbonnais et Centr. France, 1905, pp. 204–216.

[5] Sur quelques Diptères et une Hyménoptère du Copal Récent de Madagascar. Miscell. Entom., XIII, p. 6, Narbonne (1905).

Phora (*sensu stricto*) without the slightest doubt. In neither case are the wings preserved, but the wonderful preservation of the bristles on the body and legs makes generic reference easy.

Phora cockerelli sp. nov.

Female. Length 4.5 mm. Body dark colored, with the pleuræ and legs brownish, although the posterior femora and tibiæ are more or less piceous. Antennæ brownish yellow, rounded; palpi apparently large and well-developed at the tips with the usual bristles which are very distinct but of only moderate size. Front shining and apparently rather long, its chætotaxy not distinguishable. Thorax shining, finely hairy. Abdomen of the usual tapering form, the second segment not at all lengthened. Venter pale and membranous as usual. Legs moderately stout for the genus *Phora*. Anterior tibiæ with a single rather small external bristle at the anterior third, followed by a series of smaller diminishing ones in a line to the tip, none of which are very much larger than the hairy vestiture of the tibia. Middle tibia with a single large external bristle at the basal third; one large and one very short apical spur. Posterior tibia with an external bristle at the extreme base (indicated in the specimen only by an unmistakable cicatrix on the surface); a cluster

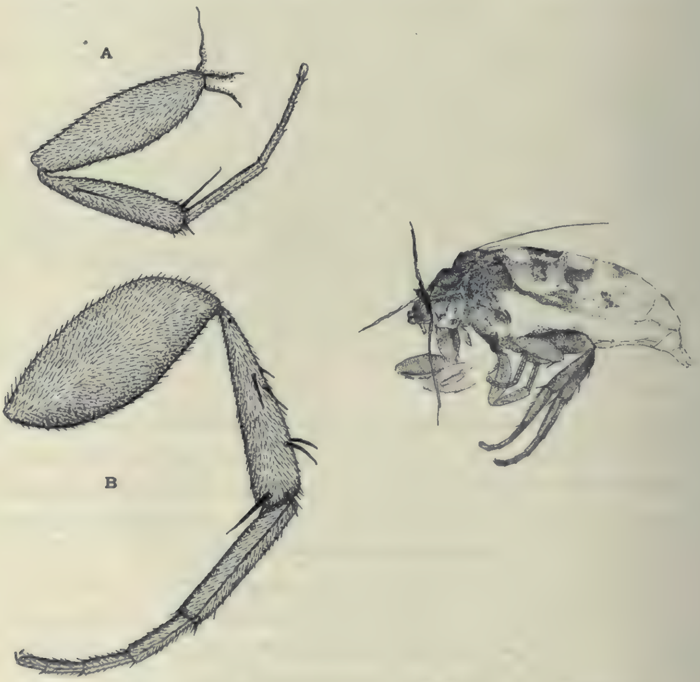


Fig. 1. *Phora cockerelli*, sp. nov. A. Anterior leg. B. Posterior leg.

of three at the basal third and a pair at the apical third; tip with one long and two short spurs. Tarsi normal, the hind metatarsus inwardly with the characteristic transverse rows of bristly hairs.

One specimen, from Florissant, Colorado (Prof. Cockerell's Station 17). Type in the collection of the American Museum of Natural History.

The present species is closely allied to several recent species, at least in the armature of the tibiæ. A careful examination reveals a trace of one wing where its base is superimposed upon the thorax, but the larger expanse is entirely obliterated.

Phora laminarum sp. nov.

With the exception of the hind legs, the type of this species is so poorly preserved that it can scarcely be described. The length is about 5 mm. Color apparently brownish yellow, with the head and several basal patches on the abdomen darker. Both hind legs are, however, beautifully preserved and their structure serves to place the species very accurately. On the outer side of the tibia is a series of closely approximated transverse rows of short bristly hairs almost exactly similar to the arrangement seen in the recent North American species, *Phora multiseriata* Aldrich. At its tip are several spurs, and the metatarsus is also furnished inwardly with a number of long bristles. The antennæ are rounded but very poorly preserved. There is no trace of wings, but from the stout form of the species there can be no doubt that it was winged.

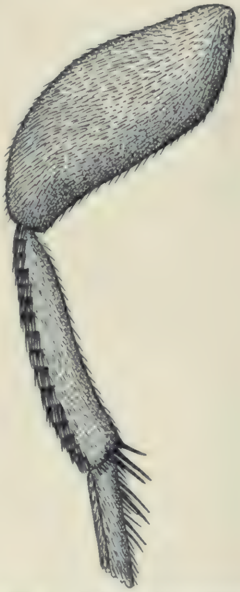


Fig. 2. *Phora laminarum*, sp. nov. Hind leg.

One specimen, collected by Mrs. W. P. Cockerell at Florissant, Colorado (Station 14). Type in the collection of the American Museum of Natural History.

The remarkable similarity which this shows to *P. multiseriata* suggests that its affinities are North American, although it is quite possible that it may depart radically from that species in venation or other characters not shown in the fossil.

Public Museum, Milwaukee, U. S. A.
February 7, 1908.

59.9,51B(26.1N)

Article XVIII.— THE NORTH ATLANTIC RIGHT WHALE AND ITS NEAR ALLIES.

By J. A. Allen.

Plates XIX–XXIV.

Contents.

Page.
I. Introduction 277
II. Historical 280
Recognized as different from the Greenland Whale by whalers of the 17th and 18th centuries 281
Recognized as a distinct species by 18th century systematists 288
Nineteenth century researches and opinions 290
Origin of the name *Balæna biscayensis* 291
Balæna cisarctica Cope 293
Eschricht, Gray, and Van Beneden, 1861–1871 293
Paul Fischer, 1871–1881 298
Balæna tarentina Capellini 299
Gasco, 1877–1879 299
Holder, 1883 300
Flower, 1864–1891 301
Guldberg, 1884–1893 302
Van Beneden, 1885 302
Graells, 1889 303
Jouan, 1890 303
Ridewood, on the structure of the 'bonnet,' 1901 303
True, 1904 304
Andrews, 1908 305
III. Relationships and Nomenclature 306
Relationships 306
Nomenclature 308
Synonymy and bibliographical references 310
IV. Geographical Distribution 312
V. External and osteological characters 320
Provincetown specimen 322

I. INTRODUCTION.

No indigenous mammal of our fauna has occupied a more important place in commercial history than the Right Whale of the North Atlantic, nor is there any other whose history extends so far into the past. Its economic products — oil and whalebone — added greatly for many centuries to the comfort and welfare of the civilized world. Its pursuit served as a training school for seamen, since its capture required skill, courage, and endurance, and entailed much hardship and personal risk. Its history is thus interwoven with the seafaring annals of the maritime nations of Europe from the tenth to the end of the seventeenth century, and with those of this country from the earliest settlement of the Atlantic coast to near the close of the eighteenth century, when incessant pursuit had accomplished its commercial extinction. It was not, however, till nearly a hundred years later that specimens of the animal were available to naturalists for examination, and it received proper recognition in modern zoölogy. From the standpoint of to-day it is possible to trace its history for nearly a thousand years, but exact knowledge of its distinctive characteristics and relationships is of recent date.

The literature relating to its history is exceptionally voluminous, but prior to 1860 is mostly of a commercial and more or less statistical character; there are, however, from the earliest times, references to its habits, external characters, and places of occurrence, and its gradual extirpation as a species of economic importance is easily traced. Its zoölogical status was first announced by the Danish naturalist Eschricht in 1860, from examination of a specimen captured at San Sebastian, Spain, but the death of this author soon after prevented his making known the details of its structure, which were first briefly indicated by Cope, in 1865, from a specimen taken in Delaware Bay. From these dates began its modern technical history, the bibliography of which numbers scores of titles. In the following pages an attempt is made to summarize this voluminous literature, relating to an almost extinct member of our New York fauna.

The North Atlantic Right Whale is at present represented in the museums of Europe by only three skeletons, all taken in European waters, and all representing more or less immature individuals. In this country it is represented by skeletons in several of the principal museums, all taken during the last fifty years, at various points on the Atlantic coast of the United States, from Cape Cod to Charleston. The mounted specimen in this Museum was one of the first to be installed for exhibition, and the first to be figured and described in detail.[1] Last year the Museum collection was further enriched by two others captured on the southern coast of Long Island.[2]

The early history of the North Atlantic Right Whale, at least in outline, is an oft-told tale. It was first disentangled from that of other species by

---

[1] By the late Dr. J. B. Holder, then Curator of Zoölogy, in the first volume of the Museum 'Bulletin,' in 1883.

[2] Since the above was written the younger of these two specimens has been sent to the University Museum of Zoölogy, Cambridge, England, in exchange for other material.

Eschricht in 1861 (as noted beyond), in a memoir that is a classic in cetological literature. Since this date many important details have been added by other writers, in various languages, especially in relation to the early Basque whale-fishery carried on for centuries along the western coast of Europe, based on this species. There are also many recent records of its capture or occurrence in both European and American waters, indicating that it is again slowly on the increase in some of its old-time haunts. There is, however, no connected and adequate summary, comprising its technical as well as non-technical history, at present extant, but numberless references, partial histories, and original contributions of widely varying importance. Most of these are cited *passim* in the following pages, with more or less descriptive or critical comment.

The North Atlantic Right Whale is now well known in comparison with its congeners of other oceanic areas. Its North Pacific representative, which has figured in literature for a century, and has been pursued by American and other whalemen for three fourths of a century, is still zoölogically almost unknown; it is represented in museums by only a few blades of whalebone, and its general history rests mainly upon Scammon's account[1] of it and his figures of its external form. The most that can be said of it is that it apparently differs widely not only from the Arctic, Bowhead, or Greenland Whale, but from the right whales of the North Atlantic and southern seas. The right whales of the southern hemisphere are entirely unrepresented in the museums of this country, and, with the exception of one of the species (*Eubalæna australis*), are also almost wanting in European museums. There is, furthermore, not a skeleton, and only one or two more or less imperfect skulls, of the common Greenland Whale in the museums of America, which has been pursued for its commercial products by American whalemen for centuries. During the last few years this Museum, largely through the liberality of Mr. George S. Bowdoin of New York City, has made a good beginning toward securing a collection of skeletons and other material to illustrate this great order of marine mammals; and in view of the urgent need of prosecuting this work with vigor, it is hoped that the means will be forthcoming for greatly increasing the world's knowledge of these little known animals.

Personal Note.— Nearly thirty years ago — 1880–1882 — the present writer undertook the preparation of a work on the Cetacea and Sirenia of North America, to be published as a volume of the quarto Reports of the United States Geological and Geographical Survey of the Territories, then under the direction of the late Dr. F. V. Hayden. As a preliminary step in this work, the compilation of an annotated bibliography of the Cetacea and Sirenia was undertaken, to cover the period from Albertus Magnus to the end of the year 1880. The first third, extending from 1495 to the end of the year 1840, and comprising about one thousand titles, was published in 1882 [1]; the rest (more than two thousand titles, comprising the most important part from the systematic standpoint) remains still in manuscript. The preparation of the text of the monograph (on the same general plan as the author's previously published volume on the Pinnipedia [2]) was well advanced, several species of the Baleen or Whalebone Whales being practically completed. Twelve quarto plates, relating to the osteology of the Baleen Whales, had been lithographed from drawings carefully made under the author's supervision by Mr. James Henry Blake of Cambridge, Mass. At this point the work was suddenly interrupted by the author's serious illness, resulting in a prolonged period of invalidism. During this interval the "Hayden Survey" ceased to exist, and the reorganized Geological Survey, made no provision for the completion of the unfinished zoölogical work begun under the Hayden Survey. Later other interests engaged the author's attention, and nothing further was done on the proposed monograph of the Cetacea and Sirenia.

---

[1] C. M. Scammon. The Marine Mammals of the North-western Coast of North America, described and figured. 4to, San Francisco, 1874.

In the meantime several important contributions [3] have been made to the history of the North American Cetacea, relating especially to the field covered by the nearly completed portions of my monograph as left in 1882. Yet my work of 1882 has been only in part duplicated.

The recent acquisition by this Museum of considerable cetological material has led me to examine this long-stored manuscript and its illustrations, and the present article is primarily based thereon, with such revision and additions as the lapse of more than a quarter of a century has rendered necessary. It is published in the present connection with the approval of the Secretary of the United States Department of the Interior, under the auspices of which it was originally undertaken.

II. HISTORICAL.

Although the earliest references to the North Atlantic Right Whale are somewhat vague, its history can unquestionably be traced back to the ninth and tenth centuries, at which period it is known to have been the basis of whale-fisheries prosecuted by the Basques and Norwegians. According to Markham's researches,[4] the Basque whale-fishery "was a well established trade in the twelfth century; so that," he concludes, "it probably existed at least two centuries earlier." He found that as early as 1150 whalebone was one of the articles of merchandise subject to warehouse duties at San Sebastian; and that in 1203, 1204, and 1237, the same regulations were imposed in other cities of the Basque Provinces. It is further recorded, he tells us, that "in accordance with custom," the "King should have a slice of each whale" taken, etc., which he regards as a further indication of the antiquity of the fishery. He also cites documents in which is recorded a list of the whales killed by the boats of the single port of Lequeitio from 1517 to 1661, and also similar records kept at other ports, which indicate that the whales were already declining in numbers off the Basque coast. He says: "It is clear that the whales, close along the coast, became very scarce in the middle of the seventeenth century, when entries at Lequeitio cease, and the Basque sailors then began to seek the means of exercising their special craft by making long voyages, even to the Arctic regions. Such voyages were occasionally made at a still earlier period. It is stated by Madoz that a pilot of Zarauz named Martin de Echeveste was the first Spaniard who visited the banks of Newfoundland, and that, according to a memoir written by his son, he made 28 voyages from 1545 to 1595, the year of his death."[1]

---

[1] Preliminary List of Works and Papers relating to the Mammalian Orders Cete and Sirenia. By Joel Asaph Allen. Bull. U. S. Geol. and Geogr. Survey of the Territories (Hayden), Vol. VI, No. 3, pp. 399–562. Published August 30, 1882. 1013 titles, 1495–1840.

[2] History of North American Pinnipeds, a Monograph of the Walruses, Sea-Lions, Sea-Bears, and Seals of North America. U. S. Geol. and Geogr. Survey of the Territories (Hayden). Misc. Publ. No. 12, 1880, 8vo, pp. xvi + 785.

[3] Especially Dr. J. B. Holder's paper on the Right Whale of the North Atlantic, published in the first volume of this 'Bulletin,' and Frederick W. True's the 'Whalebone Whales of the Western North Atlantic,' published in 1904.

[4] On the Whale-Fishery of the Basque Provinces of Spain. By Clements R. Markham. Proc. Zool. Soc. London, 1881, pp. 969–976.

EARLY RECOGNIZED BY WHALEMEN AS DISTINCT FROM THE GREENLAND WHALE.

At about this time (1596) the Arctic, Bowhead, or Greenland Whale first became known to Europeans, and soon, on account of its easier capture, greater yield of oil and whalebone, and especially its greater abundance, this species became the chief basis of the Northern Whale-fishery, prosecuted with so much industry for the next three centuries. In consequence of its discovery we obtain our first definite information respecting the distinctive characters of the Right Whale of temperate waters, after it had practically reached commercial extinction. Previous records fail to give any satisfactory clue to its distinguishing features, and it is only through these early comparisons of the two species that we first become aware of their differences; it was two centuries and a half later before they were properly set forth through the study of actual specimens by competent naturalists. That the two species were recognized by the whalemen of the early part of the seventeenth century as two distinct kinds of whale is evident from the earliest comparative references to them, as shown by the following transcripts, which possess exceptional historic as well as scientific interest.

We first meet with tangible evidence of the recognition of whalebone whales in the "Commission for Thomas Edge,....appointed to go as.... Factor in the Ship called the *Mary Margaret*,....for the killing of Whale and Morses upon the coast of *Greenland* [*i. e.*, Spitzbergen], or any other place in the North Ocean," issued by the Muscovie Company of London March 31, 1611. These instructions about whales are believed to have been based on information derived from Biscay whalers. "The first sort of Whales" is the Greenland Whale, here briefly described under the name "Bearded Whale." "The second sort of Whale," say these instructions, "is called *Sarda*, of the same colour and fashion as the former, but somewhat lesse, and the finnes not above one fathom long, and yieldeth in Oyle, according to his bignesse, sometimes eightie, sometimes a hundred Hogsheads." The "Bearded Whale" is said in the same connection to yield "betweene one hundred and one hundred and twentie Hogsheads of Oyle." [1]

---

[1] Markham, *l. c.*, pp. 972, 973.

In Edge's account of his "ten seuerall Voyages" (1611–1622), he gives "The Description of the seuerall sorts of Whales, with the manner of killing them," in which this same "second sort of Whale" is thus described: "The second sorte of Whale is called *Sarda*, of the same colour as the former [the Greenland or "Bearded" Whale, here called "Grand-bay Whale," "from *Grand-bay* in Newfoundland, as hauing there beene first killed"], but somewhat lesser, and the Finnes [baleen] likewise lesser, and yields in Oyle according to his bignesse, sometimes seuentie hogsheads, or eightie hogsheads. This Whale hath naturally growing upon his backe, white things like vnto Barnacles." [2] The "Grand-bay Whale" is here said to yield "about one hundred hogsheads of Oyle, and some fiue hundred Finnes." The "Sarda" is characterized as being smaller, with shorter baleen, and as yielding much less oil than the Greenland Whale, and as having "white things" growing on its back, the last, as will appear later, a distinction of much importance.

Martens, writing some fifty-two years later, briefly alludes to this species in the same comparative way. He says (I here quote an early English translation): "The *Whales of the North Cape* (they are so called, because they are caught between *Spitzbergen* and *Norway*) being not so big, therefore do not yield so much Fat as those of *Spitzbergen*, for those of the *North Cape* you shall not fill above ten, twenty, or thirty Cardels of Fat; the middling sort of those of Spitzbergen yield commonly seventy, eighty or ninety, and they are about fifty or sixty foot long." [3]

Zorgdrager devotes a chapter [4] to the Nordkaper, besides making passing allusions to it elsewhere. He gives us little information, however, about its distinctive characters, although recognizing it as a distinct species from the "Eilandsche Vissch" or Greenland Whale. He speaks of it as a southern whale, rarely or never appearing within the range of the Greenland Whale. He quotes several statements from Martens, and among others this: that in the stomach of a small whale called "Noordkaper," taken near Hetland, was found a barrel of herrings.[1] In substance his account of its size and yield of oil is not different from those given by Edge and Martens. On the hearsay statement that it feeds upon fish he ventures the opinion that the reason it frequents the coasts of Iceland and Norway is on account of the abundance there of the small fish that form its prey.

---

[1] Purchas, his Pilgrims, III, 1625, p. 710.

[2] Purchas, his Pilgrims, III, 1625, p. 471.

[3] An Account of several Late Voyages and Discoveries. London, 1711, [pt. ii,] p. 151. For the original see Martens's Spitzbergische oder Groenlandische Reise-Beschreibung, gethan im Jahr 1671. Hamburg, 1675, p. 106.

[4] Bloeyende Opkomst der Aloude en Hedendaagsche Groenlandsche Visschery. Amsterdam, 1720, pp. 91–98.

Egede, in his 'Description of Greenland' (originally published in Danish in 1741), adds little that is new to its history. His account is in substance Martens's and Zorgdrager's combined, and probably reflects the knowledge of the species then current among whalemen. He says these whales are "called North Capers, from their place of abode, which is about the North Cape of Norway, though they also frequent the coasts of Iceland, Greenland, and sundry other seas, going in search of their prey, which is herring and other small fish, that resort in abundance to those coasts. It has been observed that some of these North Cape whales have had more than a tun of herrings in their belly.[2] This kind of whales has this in common with the former called fin-whale [which he has just described], in that it is very swift and quick in its motion and keeps off from the shore in the main sea, as fearing to become a prey to its enemies, if it should venture too near the shore. His fat is tougher and harder than that of the Great-bay Whale; neither are his barders or bones so long and valuable, for which reason he is neglected." [3]

Anderson, in his 'Nachrichten von Island,' published in 1747, adds also little to the history of the Nordkaper beyond a grotesque account of the way the Icelanders capture it, which Harrebow pronounced purely a fabrication.

In regard to the "Sletbag" of the Icelanders, Eschricht and Reinhardt believe that they are able to trace its history back to the "celebrated 'Konge-speil' (Mirror of Royalty) of the 12th century," and quote from it passages which seem to refer to it, as well as others from later Icelandic writings. In commenting on the information derived from these sources they say "We learn....that this 'Sletbag' of the old Icelanders was really a whalebone whale (and therefore as a whalebone whale with a finless back, a right-whale), but we learn also, on the unequivocal authority of contemporary persons, on the one hand, that this was the whale at that time most commonly caught near the coast of Iceland, especially by French and Spanish whalers, who in the seventeenth century and still long afterwards every summer used to carry on a lucrative whale-fishery in the Icelandic sea, and on the other hand, that this 'Sletbag' was an animal very different from the North or Greenland whale." They later quote from an Icelandic manuscript supposed to have been written about the middle of the eighteenth century a passage about the Sletbag, and finally summarize the matter as follows: "At all events, so much seems finally proved by these statements of ancient and more modern dates, that the Icelanders have at all times agreed in regarding the 'Sletbag' as an animal quite different from the North whale, or the Greenland whale, being, in fact, a right-whale of inferior size, and with much shorter whalebone; and, at the same time, it is proved beyond all possibility of doubt, that this 'Sletbag' of the Icelanders was the very one that was hunted by the Basques in the summer, in the sea near Iceland, during the long period of at least two centuries." [1]

---

[1] This statement is of special interest as being the origin of the report, repeated by scores of subsequent writers, including the early sysematists, that the Nordkaper is a fish-eating species. Martens, however, gave the information at second-hand, as his words, here following, distinctly show: "Ich habe von andern vernommen. dass bey Heitland ein kleiner Wallfisch gefangen, ins gemein Nord-Kaper genandt, der hat mehr als ein Tonne Hering bey sich gehabt." — Spitsbergeisch eoder Groenlandische Reise-Beschreibung, p. 107.

[2] He evidently here alludes to Martens's report about the Heitland whale already quoted.

[3] **Description of Greenland, 2d London ed., 1818, p. 73.**

Respecting the occurrence of the Sarda or North-caper about Newfoundland and southward, the annals of the New England whale-fishery afford items of information of special interest. In Paul Dudley's well-known account of the New England Whales and Whale-fishery, written doubtless as early as 1724 and published in 1726,[2] we have a rather detailed account of what he calls "The Right Whale," which runs as follows: "But here I would have it noted, that the following Account respects only such Whales, as are found on the Coast of *New England*.

"And of these there are divers Sorts or Kinds. As first, The Right, or Whalebone Whale is a large Fish, measuring sixty or seventy Feet in Length, and very bulky, having no Scales, but a soft fine smooth Skin, no Fins, but only one on each Side, from five to eight Feet long, which they are not observed to use, but only in turning themselves, unless while young, and carried by the Dam on the Flukes of their Tails; when with those Fins they clasp about her Small, and so hold themselves on. This Fish, when first brought forth, is about twenty Feet long, and of little Worth, but then the Dam is very fat. At a year old, when they are called Short-heads, they are very fat, and yield to fifty Barrels of Oil, but by that Time the Dam is very poor, and term'd a Dry-skin, and won't yield more than thirty Barrels of Oil tho' of large Bulk. At two Years old, they are called Stunts, being stunted after weaning, and will then yield generally from twenty four to twenty eight Barrels. After this, they are term'd Scull-fish, their Age not being known, but only guess'd at by the Length of the Bone in their Mouths. The Whalebone, so called, grows in the upper Jaw on each Side, and is sometimes six or seven Feet in Length. A good large Whale has yielded a thousand Weight of Bone. 'Tis thought by some, that the hairy Part of the Whale-bone, and which is next to the Tongue, serves in the Nature of a Strainer of their Food....The Entrails of this Whale are made and situated much like those of an Ox, and their Scalps are sometimes found covered with Thousands of Sea-lice. One of these Whales has yielded one hundred and thirty Barrels of Oil, and near twenty out of the Tongue" (*l. c.*, pp. 256, 257).

---

[1] Memoirs on Recent Cetacea, pp. 32–33.

[2] Phil. Trans., XXXIII, 1724–1725 (1726), pp. 256–269.

William Douglas, in his 'Summary, Historical and Political,....of the British Settlements in North America' (London, 1760), gives an account of the New England Whale-fishery, in the course of which he says: ".... The New-England true whale is the same with the European North-cape whales, are not easily killed, being agile and very wild; the Dutch do not fish them....Upon the coast of New England, whales go northward from the middle of March to the middle of May" (*op. cit.*, pp. 297, 298). In another connection he again refers to the subject, incidentally comparing the New England "true" Whale with the northern or Greenland Whale, but evidently not distinguishing them as two species; yet his comparison serves, taken in connection with the passages above-quoted, to throw into relief the differences between the two. It also shows that a little allowance for exaggeration is to be made in reference to the length given for the "bone" of the New England "true" Whale. He says: "The New England whalers distinguish ten or twelve different species of the whale-kind; the most beneficial is the black whale, whale-bone whale, or true whale, as they call it; in Davis's-straits, in N. lat. 70 D. and upwards they are very large; some yield 150 puncheons, being 400 or 500 barrels of oil, and bone of eighteen feet and upwards; they are a heavy loggy fish, and so do not fight, as the New-England whalers express it; they are easily struck and fastened, but not above one third of them are recovered; by sinking and bewildering themselves under the ice, two thirds of them are lost irrecoverably; the whale-bone whales killed upon the coast of New England, Terra de Labradore, and entrance of Davis-straits, are smaller; do yield not exceeding 120 to 130 barrels of oil, and of nine feet bone 140 lb. wt. they are wilder more agile and do fight" (*op. cit.*, p. 56).

Hector St. John's 'Letters from an American Farmer' (London, 1782), contain an account of the Nantucket whale-fishery, in which he gives, "the names and the principal characteristics of the various species of whales known to these people." He says "the river St. Lawrence whale" is the only one with which he was well acquainted, which he describes as "seventy-five feet long, sixteen deep, twelve in the length of its bone, which commonly weighs 3000 lb. twenty in the breadth of their tails and produces 180 barrels of oil." He afterwards, in his enumeration of the species, includes "The right whale, or seven feet bone, common on the coasts of this country,' about sixty feet long" (*op. cit.*, pp. 167, 169).

It thus appears that the Right Whale of the eastern coast of the United States was regarded by whalers as not only distinct specifically from the Greenland Whale, but also as identical with the whale of the North Cape. It seems, indeed, to have been generally known among New England whalers, down to the last part of the nineteenth century, as the "North-caper," as I have learned from Provincetown whalers formerly engaged in the pursuit of whales in the Gulf of St. Lawrence. Their "North-caper" (also called "Black Whale") was not only smaller, yielding less oil and much shorter bone, but had a "bonnet" infested with parasitic cirripeds, and was migratory, passing north in spring and south in autumn.

Eschricht and Reinhardt,[1] in speaking of the species now under consideration, present the following summary of the results of their investigation of its early history: "Much as we could wish, on reviewing the above-mentioned statements derived from very different authors, that the historical evidence about the whale mentioned by the name of 'Sletbag,' 'Sarde,' or 'Nordkaper,' had contained a more complete description of it, yet it must be admitted that they are sufficient to prove our former assertion, that the ancient Icelanders as well as the whalers of different nations really used to distinguish between this whale and the Greenland whale, and that this distinction was in all respects well founded. As certain characteristics of the 'Sletbag,' we are already enabled to point out the following:

"1. That it was much more active than the Greenland whale, much quicker, and more violent in its movements, and accordingly both more difficult and more dangerous to catch.

"2. That it was smaller (it being, however, impossible to give an exact statement of its length), and had much less blubber.

"3. That its head was shorter, and that its whale-bone was, comparatively speaking, much thicker, but scarcely more than half as long as that of the Greenland whale, being however still much longer than that of even the very largest fin-whale, although the 'Sletbag' itself probably scarcely attained to half the length of the last-named.

"4. That it was regularly infested with a cirriped belonging to the genus *Coronula*, and that it belonged to the temperate North Atlantic as exclusively as the Greenland whale belonged to the icy Polar sea, so that it must be considered as equally exceptional when either of these species strayed into the range of the other, and, moreover, that in its native sea it was to be found farthest towards south in the winter (namely, in the Bay of Biscay and near the coast of North America, down to Cape Cod [and even to the Carolinas]), while in the summer it roved about in the sea round Iceland, and between this island and the most northerly part of Norway [and also about Newfoundland].

---

[1] The extracts here following are from the English translation of their 'Om Nordhvalen' (1861) published by the Ray Society in 1866, in 'Recent Memoirs on the Cetacea,' pp. 39–41.

"The existence of such a North Atlantic right-whale may be said to be so certain, that it is much more surprising that it ever should have been omitted in the zoological system than that it has now, as we hope, regained its former place in it. The reasons why Scoresby, and afterwards Cuvier, would not acknowledge it as a separate species,[1] were, besides an insufficient knowledge of the historical evidence relating to it, partly the fact of the former's not having seen anything of it on his many whaling expeditions, and partly the great resemblance to the Greenland whale, so evidently seen in the only picture given of the 'Nordkaper.' Neither of these reasons will, however, on a closer consideration, seem particularly weighty. . . . We may also say that the drawings of the 'Nordkaper,' [2] which, as we have mentioned, are published by Lacèpède, have been thought far too much of, when they have been called the only evidence of any authenticity of the existence of this whale,[3] and when it has been inferred, from the circumstance of their exhibiting scarcely any difference from the genuine Greenland whale,[4] that the 'Nordkaper' must be identical with this animal. In order to make such an inference we ought to have ascertained beforehand whether these drawings do really represent the 'Nordkaper' properly so called, and whether this name, so frequently misused, has not been misapplied in this instance too; but here we have no means of arriving at a certain conclusion. Lacèpède tells us that he obtained the drawings from Sir Joseph Banks three months before the publication of the 'Histoire Naturelle des Cétacés' (1804), with the information that they were drawn in Greenland by Bachstrom in the year 1779.[5] But in Baffin's Bay the 'Nordkaper' is as rare as in the sea near Spitzbergen. According to what we have stated above, only single individuals, at many years' intervals, have strayed thither, and it is not very probable that Mr. Bachstrom really had an opportunity of seeing one." [1]

---

[1] "In the first edition of the 'Regne Animal,' (1817), Cuvier still believed in the existence of the 'Nordkaper' (*Balæna glacialis* Kl.) (l. c. vol. i, p. 286). It was not till in the 'Recherches sur les ossemens fossiles,' and in the essay: 'Sur la détermination des diverses espècès de Baleines vivantes' (in 'Ann. d. Sc. nat.' T. ii, 1824), that it was abandoned, and it is easily to be seen that this alteration in Cuvier's opinions was, to a great extent, occasioned by the statements of Scoresby."

[2] "Lacëpède Hist. nat. des Cetacés, pl. 3."

[3] "'Le seul document muni de quelque authenticité que l'on ait cru pouvoir y rapporter.' Cuvier, 'Recherches sur l. oss. foss'. 4me Ed. T. viii, p. 256."

[4] "Scoresby, Acc. vol. i, p. 448, note. Cuvier, l. c. p. 257."

[5] "'Hist. nat. d. Cétacés, p. 108.' 'Ce Cétacé' (le Nordkaper) vit dans la partie de l'Ocean atlantique septentrional située entre le Spitzberg, la Norvège et l'Islande. Il habite aussi dans les mers du Groenland, oû un individu de cette espèce a été dessiné, en 1779, par Mr. Bachstrom, dont le travail, remis dans le temps à Sir Joseph Banks, m'a été envoyé, il y a trois mois, pas cet illustre, &c.'"

These authors go on to state that Scoresby, knowing that the Greenland Whale, "made for seas filled with ice," was not likely to "have appeared regularly far down in the Atlantic along the coasts of France and Spain," attempted to explain the accounts of the old Basque whale-fishery on the ground that it was based on the capture of Fin-whales. Cuvier, well aware that such an explanation was inadmissible, "accordingly did not fall into Scoresby's error, but, following his authority in supposing the 'Nordkaper' and the 'Greenland whale' to be the same animal, he was led into the mistake of rejecting what was right in Scoresby's reasoning, and of setting forth the older theory that the whale has been gradually driven up into the Arctic Sea, in all its crudity." [2] [Here follow quotations from Cuvier's writings on this point, giving his reasoning in the matter.]

RECOGNIZED AS A DISTINCT SPECIES BY THE 18th CENTURY SYSTEMATISTS.

The Nordkaper was introduced into systematic zoölogy by Klein, in 1741,[3] under the name *Balæna glacialis,* but evidently as a composite species, having in part reference to the true Greenland Whale. He makes of it three varieties, viz: *a, australis* = "Eisfisch," Zorgdrager; *b, occidentalis* = "Zud-Eisfisch," [4] Zorgdrager"; *c, borealis* = "Nordkaper," Zorgdrager. The last can alone certainly refer to the Nordkaper, and his account of it is, in full, as follows: "*C. Borealis*; Nordkaper, *Ejusdem* [*i. e.*, Zorgdrager]. Vescuntur & *esca* Balænæ veræ & Harengis &c. Adeps earum majoris est consistientiæ; ideo non adeo sollicite qværuntur. Figuram Borealis vid Eph. N. C. G. Dec. II, An. VII, Obs. XXI, Optamus meliorum." Klein's *Balæna glacialis, c. borealis,* is therefore the Nordkaper of Zorgdrager, which has been already considered.

Brisson, in 1756, gave [5] it a far better introduction under the name *Balæna islandica,* or "La Baleine d'Islande." Although he cites only Klein (as above) and Harrebow's Anderson, he presents its characters, as then known, with brevity and precision, as follows: "Elle ressemble par sa figure à la précedénte ["la Baleine ordinaire de Groenland"]: elle en differe seulement parce qu'elle a la tête & les lames de corne, qui garnissent la mâchoire supérieure, beaucoup plus petites, & le corps plus mince. Sa peau est lisse, & d'un noir que tire un peu sur le blanchâtre. Elle se nourrit de *Harengs*. On la trouve sur les côtes de Norwege & d'Islande" (*op. cit.*, pp. 350, 351).

---

[1] "Lacèpède does not say who Mr. Bachstrom was; nor have we been able to find any other traces of such a person. He can scarcely have had any appointment in the Danish factories, and in the list of the missionaries of the brethren in Greenland, given by Crantz, the name of Bachstrom is not found. He was most probably on board a whaling ship, as the words of Lacèpède would seem to imply."

[2] Om Nordhvalen (K. Danske Vidensk. Selsk. Skr., 5 Raekke, Naturvidensk. og Math. Afd., V, 1861, pp. 463, 464); Recent Memoirs on the Cetacea, 1866, pp. 39–41.

[3] Hist. pisc. nat., Miss. ii, 1741, p. 12.

[4] On Zorgdrager's 'Ziudys-Vissch,'' see Eschricht and Reinhardt, Om Nordhvalen, p. 463; Recent Mem. on Cetacea, pp. 25, 26.

[5] Reg. anim., p. 350.

By Linné, Gmelin, Erxleben, Donndorf, and most other systematists of the eighteenth century, the Nordkaper is either treated as identical with the Greenland Whale or as merely a variety of it, or else (as in the case of Erxleben) as a species not satisfactorily determined.

Bonnaterre, however, in his 'Cetologie,' published in 1789, again gave it full specific rank, adopting for it the not very appropriate name *Balæna glacialis*. He cites as authorities Anderson, Brisson, Horrebow, and Klein. The characters given are, however, substantially those mentioned by Brisson. He adds that "il est tres-dangereux de harponner cet animal, à cause de son extrêmé agilité." We have here set forth all the traits and characters of the animal as it was known prior to the middle of the nineteenth century, except that its habitat is given merely as the "mers du Nord, près des côtes de Norwege & d'Islande." It is properly introduced under a binomial Latin designation, appropriate enough as its habitat was then understood. It, however, only visits its northern habitat during its summer migration, and is not, strictly speaking, an animal of the glacial seas to the extent the name *glacialis* might be supposed to imply.

Lacépède, in 1804, retained[1] it as a species under the name *Balæna nordcaper* and gave supposed figures of it, after drawings by Bachstrom, but which, as Eschricht and Reinhardt believe, really relate to *Balæna mysticetus* (see *antea*, p. 287). The characters given are derived from preceding authors, and his account (aside from the figures) relates to the true Nordkaper.

As already detailed in the words of Eschricht and Reinhardt (see *antea*, p. 287), Cuvier rejected the species altogether in his memoir 'Sur la détermination des diverses espèces de Baleines vivantes,'[2] influenced apparently by the theory that the Greenland Whale formerly ranged far to the southward and had been driven to seek safety from the persecutions of whalers in the icy seas of the north, and by Scoresby's opinion that the Nordkaper did not exist as a species distinct from the Greenland Whale. Cuvier's well-known rigid criticisms of the literature of cetology led him into error in other cases as well as in this, he rejecting species that were not based on what he deemed tangible characters. At the same time, he succeeded in placing the general subject on a much higher scientific plane, although in the vast amount of rubbish he swept away were some vestiges of truth. He showed, from osteological considerations, that the Greenland Whale was specifically distinct from at least one of the Right Whales of the southern hemisphere — the Baleine du Cap, afterwards named *Balæna australis*, and to which for many years were referred by numerous authors all the Right Whales of the southern waters.

---

[1] Hist. nat. des Cétacées, pp. 103–110, pll. ii, iii.

[2] Ann. des Sci. nat., II, 1824, pp. 27–41; Ossem. foss., V, 1823, pp. 359–388.

NINETEENTH CENTURY RESEARCHES AND OPINIONS.

It is hardly necessary to follow in detail the history of the species through the long list of systematic writers down to recent times, who, according to personal predilections, recognized it as specifically distinct or as referable to the Greenland Whale, since nothing of importance was added to its history down to the capture of the young example in the port of San Sebastian in 1854. This was fortunately figured by Dr. Monedero,[1] and the skeleton was later acquired by Eschricht for the University Museum at Copenhagen. In 1858, Eschricht received, through his friend Professor Geffroy of Paris, a copy of Dr. Monedero's lithographed sketch of the animal, in which he recognized at once a species very different from the Greenland Whale. He immediately hastened to Pampeluna, where the skeleton had been preserved, and secured it for future study at Copenhagen, to which place it was at once transported. On his return from Pampeluna Eschricht visited Paris, and laid before the French Academy his celebrated memoir 'Sur une nouvelle méthode de l'étude des Cétacés,'[2] in which he says: "Il devient donc plus que probable que les Baleines franches qui jadis furent l'object d'une pêche dans le golfe Biscayen et dans le partie septentrionale de l'Atlantique, ont appartenue à une espèce différente de toutes les autres" (*l. c.*, p. 60), and promised later to communicate the results of his investigations of its skeleton. He here mentions, however, no distinctive characters, nor does he refer to it by any particular name, either scientific or vernacular.

In 1860, he favored the French Academy with a communication entitled 'Sur les baleines franches du golfe de Biscaye,' [3] but we vainly look here for what the title so encouragingly leads us to hope for. No details regarding its structure are presented, but the statement is made that it is distinguishable by striking differences both from the Greenland Right Whale and the Baleine du Cap. His last public reference to the subject appears to have been in the memoir 'Om Nordhvalen,' published in 1861, in which he promised the special results of his examination of the young skeleton in a future essay; "here it may be sufficient to state, that he has succeeded in establishing the fact, that the Nordkaper, though belonging to the group of South Sea whales, is really, as we had supposed, an independent species perfectly different from the Cape whale." [1]

---

[1] Copia al naturel del Ballenato muerto en la playa de S. Sebastian, el 17 de Enero de 1854, hecha por las indicaciones y direccion del D^{or} Monedero. The figure (the only authentic one of the species extant prior to 1879) is reproduced in Gervais and Van Beneden's "Ostéographie de Cétacés," livr. 3, 1868, pl. vii.

[2] Compt. rend. de l'Acad. des Sci., XLVII, 1858, pp. 51–60.

[3] Compt. rend. de l'Acad. des Sci., L, 1860, pp. 924–929.

Van Beneden has also stated that Eschricht contemplated giving a description of this skeleton in a new work which was to have been published at Paris but which was suspended by his death when only a few sheets had been printed.[2] Van Beneden gives the following extract from a letter from Eschricht dated the 23d of June, 1861: "Je joindrai à la seconde livraison, pour les baleines franches (*Leiobalæna*), mes recherches sur la *baleine de Biscaye* et sur la *japonica,* dont j'ai reçu un fœtus très-maltraité." [3] In the same connection Van Beneden states that Professor Reinhardt "s'est engagé à publier la description de ce squelette unique, qui se trouve au musée de l'université de Copenhagen." This skeleton remained undescribed, however, till 1879, when it was described by Gasco,[4] as noted more fully on a later page of this paper. In the meantime, however, it had become the basis of the name *Balæna biscayensis.*

Origin of the name Balæna biscayensis.— The name *Balæna biscayensis* has figured prominently since 1864 in the literature of cetology, and has been almost universally accredited to Eschricht. In none of Eschricht's published writings, however, is the term used, nor any name approaching it nearer than "Baleine franche de Biscaye."[5]

The first occurrence of the name is in Dr. J. E. Gray's paper entitled 'On the Cetacea which have been observed in the Seas surrounding the British Islands,' published in 1864,[6] in which occurs: "The Right Whale of the Bay of Biscay (*B. biscayensis*) is regarded as a different species from the *B. mysticetus* by Eschricht and Van Beneden" (*l. c.*, p. 201), without citation of their papers, or any additional comment. A few months later, in a paper entitled 'Notes on the Whalebone Whales; with a Synopsis of the Species,' [7] he more formally introduced it, as follows:

---

[1] Eschricht and Reinhardt, Recent Memoirs on Cetacea, p. 46.

[2] Milne Edwards, in 1864 (Ann. des Sci. nat., 5e sér., I, 1864, pp. 201–224), published, after Eschricht's death, from the proofsheets, this part of the proposed work, under the title 'Recherches sur la distribution des Cétacés dans les mers boreales,' which includes "I,— Introduction" (*l. c.*, pp. 201–204); "II.— La côte occidentale du Groenland" (pp. 205–224). In this there is no reference to the specimen taken in the Gulf of Biscay, nor even to the Nordkaper.

[3] Ostéogr. des cétacés, livr. 4, 1868, p. 98.

[4] Il balenotto catturato nel 1854 a San Sebastiano (Spagna) (*Balæna biscayensis*, Eschricht) per la prima volta descritto. F. Gasco. An. Mus. Civ. Stor. Nat. Genova, XIV, 1879, pp. 573–608.

[5] Compt. rend. de l'Acad. des Sci., L, 1860, p. 924.

[6] Proc. Zool. Soc. London, 1864 pp. 195–248. (Read May 24, 1864.)

[7] Ann. and Mag. Nat. Hist., 3 ser., XIV. Nov, 1864, pp. 345–353.

"2. *Balæna Biscayensis*, Esch. & Van. Ben.

"*Hab.* The Bay of Biscay. I have seen no remains of this Whale" (*l. c.*, p. 348).

Slightly later it was used by Prof. W. H. Flower, who, in his 'Notes on the Skeletons of Whales in the principal Museums of Holland and Belgium,' etc.,[1] in speaking of Gray's genus *Eubalæna*, says: "Type species, *E. australis* (Desm.) Probably several other species, including *Balæna biscayensis*, Eschr.; but these are not yet well determined" (*l. c.*, p. 391).

In 1866, in his 'Catalogue of Seals and Whales in the British Museum' (p. 89) Gray introduced this species still more formally, as follows:

"2. **Balæna Biscayensis.**

"Baleine de Biscaye, *Van Beneden, Bull. Acad. Roy. Belgique*, [(2) XII,] 1861, 462.
"Balæna Biscayensis *Gray, P. Z. S.* 1864, 200 [= 201].
"Baleine franche du golfe de Biscaye, *Eschricht, Comptes Rendus*, 1860; *Actes de la Soc. Linn. de Bordeaux*, t. 13, 4ᵉ livr. [*lege* t. XXII].
"Balæna (Eubalæna) Biscayensis, *Flower, P. Z. S.* 1864, 391.

"Inhab. Bay of Biscay, St. Sebastian. A female and its young, Jan. 1860 [*lege* 1854]. Skeleton at the Museum of Pampeluna [*lege* Copenhagen]."

This is followed by a quotation of two lines (as given above) from his 1864 paper; by a reference (4 lines) to what Cuvier stated about the occurrence of the Greenland Right Whale in the Gulf of Gascony, etc.; by six lines from Flower's above-cited paper, and ten lines from Eschricht, followed by a few lines of comment.

On an earlier page of the 'Catalogue' (p. 84), he also refers to "the whale which Eschricht has described under the name *Balæna Biscayensis*"; and later still, in 1870, in his "Observations on the Whales described in the 'Ostéographie des Cétacés' of MM. Van Beneden and Gervais," he mentions[2] the San Sebastian whale as "the specimen which has been named *Balæna Biscayensis* by Eschricht," or as "*Balæna Biscayensis*, Eschricht," etc.

Thus was introduced the name *Balæna biscayensis* into the literature of zoölogy. It was first employed by Gray in 1864, on two occasions, and again in 1866, when he gave references and synonyms; but he now ascribed its origin to Eschricht, and later abandoned it as lacking proper basis.

Eschricht was the first modern author to recognize the Right Whale of the North Atlantic as different from the Greenland Right Whale, and not only as different from it, but as having no close relationship to it, he stating it to be, on the other hand, nearly related to *Balæna australis* of the southern seas. He failed, however, to designate it technically, which was first done by Gray, who simply gave to Eschricht's vernacular designation a Latin rendering. Yet, from 1864 down to the present time, the name *Balæna biscayensis* has, with the exception of a single author (E. D. Cope, as will be noted later), been universally ascribed to Eschricht, who never even used it. In fact, it was not proposed till after Eschricht's death, which occurred February 22, 1863.

---

[1] Proc. Zool. Soc. London, 1864, pp. 384–420. (Read Nov. 8, 1864).
[2] Ann. and Mag. Nat. Hist., 4th ser., VI, Sept. 1870, pp. 197–199. 200.

Balæna cisarctica Cope.— The *Balæna cisarctica* was described by Prof. E. D. Cope in 1865,[1] from a specimen taken in Delaware Bay, opposite the city of Philadelphia, three years previously. Professor Cope refers to it as "a half grown individual," the skeleton of which, without the intervertebral cartilages, had a length of "thirty-one and a half feet," and gives a brief account of its leading osteological features. He says of it: "This species may readily occur on the European coasts, and is, no doubt, allied to, or the same as, the species pursued by the Biscay whalers, which Eschricht says is related to the *australis*. This does not appear to have been described, though catalogued without reference by Gray and Flower, under the name *biscayensis*. The species above described may be called Balæna cisarctica; its skeleton will be more fully illustrated in a future publication." He says further that it is the "Black Whale" of the whalers of the eastern coast of the United States.

Its identity with the so-called *B. biscayensis* has always been accepted by all leading writers on the Cetacea, except Gray and Fischer. Later investigation has shown that there is no reason for doubting that Cope's assumption that they are specifically the same was well founded. Indeed, his reason for calling it *Balæna cisarctica* was the fact that he evidently considered the earlier name, *Balæna biscayensis*, as practically a *nomen nudum*, and not that he considered this earlier name to represent a different species. He also, it should be noted, correctly attributed the name to Gray instead of to Eschricht, to whom, as already stated, all other writers have invariably ascribed it.

Eschricht, Gray, and Van Beneden, 1861–1871.— Three prominent names dominated the literature of cetology during a large part of the middle of the nineteenth century — D. F. Eschricht of Copenhagen, John Edward Gray of the British Museum, and J. P. Van Beneden of Belgium — so far at least as the present species, the so-called *Balæna biscayensis* "Eschricht," is concerned. Its type is the specimen captured in the harbor of San Sebastian,

---

[1] Note on a Species of Whale occurring on the Coasts of the United States. Proc. Acad. Nat. Sci. Philadelphia, 1865, pp. 168, 169. There is also a further reference to the species, *op. cit.*, pp. 180, 181. This and other papers on North American Cetacea were republished in 1866 under the title 'Contribution to the History of the Cetacea, especially of the Eastern American Coasts,' Philadelphia, 1866, pp. 1–15, in which the description of the present species occurs at pp. 1–3.

Spain, in January, 1854, which, however, though figured soon after by Monedero, remained practically undescribed till 1879. Its skeleton was secured in 1858 for the Museum of the University of Copenhagen by Eschricht, when its examination by him confirmed him in his previous opinion, based on an exhaustive study of the literature bearing on the Greenland Right Whale and the Right Whale of the North Atlantic, that these two animals were not only distinct species, but that the latter was much more nearly related to the Right Whales of the southern seas than to those of the Arctic seas. His statement of its affinities was immediately accepted by all cetologists except Gray, who, after introducing the name *Balæna biscayensis* into scientific literature, apparently by inadvertence, later took the ground that it "as a zoological species rests on very slender grounds," and considered it as "not proved that the Greenland Whale had not [formerly] a more extended distribution than at present," and had been driven by the whalers from the temperate parts of the North Atlantic to the icy seas. Van Beneden, on the contrary, accepted the species; and this and other differences of opinion between him and Gray led to a series of controversial papers which form an interesting and instructive episode in the history of the present subject.

Early in the year 1868, Professor Van Beneden published a paper on 'Les baleines et leur distribution géographique,' [1] with a map illustrating the distribution of the five species recognized by him as "Baleines proprement dites," or those having neither a fin nor a "bosse" on the back and without gular folds. Among these species is "2 La *Balæna biscayensis*" (pp. 15, 16). Its early history, in relation to its former distribution, is briefly stated, and its supposed range is indicated on his accompanying map of the distribution of the Right Whales. Unfortunately the map is incomplete, failing to show certain areas well known to be frequented by Right Whales, and somewhat erroneous as regards the ranges of some of them, as was promptly shown by Gray in a paper 'On the Geographical Distribution of the Balænidæ or Right Whales.' [2] Gray, however, while pointing out the faults of Van Beneden, committed others peculiarly his own, especially in relation to the San Sebastian specimen, of which he says: "Mr. Flower informs me that this skeleton belongs to my genus *Cuvierius*,[3] which has brittle whalebone, with a large coarse fringe (which easily splits into strips), and a bifid first rib"; and later on refers to it as "*Balæna* (*Hunterius*) *biscayensis*." He also says: "It is very doubtful if this is the Whale found on the coast of North America, as it ought to be according to Van Beneden's chart. The only reliable account of the Whale of that coast is to be found in Dudley's paper in the 'Philosophical Transactions' (xxxiii, p. 258), who says the 'Scrag-Whale' (*B. gibbosa,* Erxleben) has white whalebone, 'that won't split,' which seems to show that it was a true *Balæna*, which is separated from *Eubalæna* on account of the toughness, flexibility, and unsplitability of its whalebone; and, indeed, Dudley says the Scrag-Whale 'is nearest the Right Whale (*B. mysticetus*) in figure and quantity of oil.'" It seems unaccountable that Gray should in this connection ignore altogether the Right Whale Dudley described[1] as *the* Right Whale of the New England coast and take up his "Scrag-Whale" for comparison in the present connection — a species which has never been satisfactorily identified, and is not now recognized as a valid species.[2] But Gray's reasoning from such false premises need not be further followed. He further quotes from Cope to the effect that Cope's *Balæna cisarctica* has the first rib "single-headed," and that this species is therefore referable to his genus *Eubalæna*, while *B. biscayensis* is not thus referable.

---

[1] Bull. de l'Acad. roy. de Belgique, 2me sér., XXV, No. 1, 1868, pp. 9–21, avec une carte.

[2] Ann. and Mag. Nat. Hist., 4th ser., Vol. I, April, 1868, pp. 242–247.

[3] On this point *cf.* Flower, Proc. Zool. Soc. London, 1864, p. 391, where he refers it to Gray's genus *Eubalæna*! As *Cuvierius* is a Fin-Whale, this may have been a *lapsus pennæ* for *Eubalæna*, but the immediate context does not appear to warrant this supposition. Furthermore, Gray in 1870 (Ann. and Mag. Nat. Hist., 4th ser., VI, 1870, p. 200), stated his belief that "*Balæna biscayensis*, Eschricht," is "a *Cuvierius* with a double-headed first rib."

At about this date appeared Van Beneden's account of *Balæna biscayensis* in Van Beneden and Gervais's notable work, the 'Ostéographie des Cétecés,'[3] in which he gave a résumé of its early history, derived mainly from Eschricht and Reinhardt's 'Om Nordhvalen,' and referred to the San Sebastian whale and Cope's *Balæna cisarctica*, which latter he believed to be identical with the so-called *Balæna biscayensis*. He adds little that is new, beyond a description and figure of a tympanic bone of *B. cisarctica*, loaned him by Cope. Various subfossil remains of Right Whales, which he also figures, he considers referable to *B. biscayensis*. These are (1) two lumbar vertebræ from the coast of Ostende; (2) a mass of cervical vertebræ from the Lyme Regis of England; (3) another mass of cervical vertebræ from the isle of Sainte-Marguerite, figured and described by Lacépède as those of a Rorqual (*Balænoptera*) and later determined by Cuvier to be those of some species of *Balæna*; (4) a fragment of a rib unearthed at Furnes.

In 1870, Dr. Gray published a review of this work, under the title, "Observations on the Whales described in the 'Ostéographie des Cétacés' of MM. Van Beneden and Gervais,"[4] in which he criticised the general character of the work, as well as numerous special points, in the course of which he again took up the subject of *Balæna biscayensis*.[1] He here resumes his criticism of Van Beneden's former essay and map, already noticed, on the distribution of the Right Whales, in which connection (pp. 196–200) he takes occasion to give the history of *Balæna biscayensis*. After stating that it, "as a zoölogical species, rests on very slender grounds," and alluding to the whale-fisheries formerly prosecuted "in the Bay of Biscay and in the British Channel," he states:...."but it is not proved that the Greenland whale had not a more extended distribution than at present, after it has been the object of capture for so many years, and, on the other hand, that the specimens that wandered far away from the usual habitat of the species would not become smaller, less fat, or more active than the others, which were better fed. The same argument may explain the difference observed by whalers in the size and form of the whales caught on the coast of Iceland and the coast of Greenland. At the same time I would not deny that the whales of this latter place may not be a different species; but as yet we have not sufficient materials for separating and characterizing them" (*l. c.*, p. 197). This would seem to imply that he ignored the existence of the species he had himself formerly recognized provisionally under the name *Balæna biscayensis*. He then alludes to the San Sebastian specimen taken "in 1834" (*lege*, 1854), which he says "has been named *Balæna biscayensis* by Eschricht," and states that "he [Eschricht] thinks that he observed in the development of the various parts of the skeleton a difference from that which he had observed in the skeletons of *Balæna mysticetus*. But we must recollect that this was to support a theory that the latter whale was exclusively confined to the Polar seas and that the Right Whale of the North Atlantic must be different" (*l. c.*, p. 197).

---

[1] See *antea*, pp. 284, 285, where Dudley's account is given in full.

[2] The name Scrag Whale appears to have been long current among whalemen for a whale occurring on the eastern coast of the United States. The first original reference to the species, after Dudley's, appears to be that furnished me in 1869 by the Hon. N. E. Atwood of Provincetown, Mass., an experienced whaleman and naturalist, for my 'Catalogue of the Mammals of Massachusetts' (Bull. Mus Comp. Zoöl., I. 1869, p. 203). He says: "A species of whale known by this name [Scrag Whale], nearly allied to if not identical with the right whale, is sometimes taken here. . . . The most prominent feature is that on its dorsal ridge, near the tail, there are a number of small projections or bunches, having some resemblance to the teeth of a saw. It has no dorsal fin or hump on its back." He further speaks of it as "rare."

[3] Livr. 4, 1868, pp. 90–110, pl. vii.

[4] Ann. and Mag. Nat. Hist., 4th ser., VI, Sept. 1870, pp. 193–204.

Apropos of this statement, the criticism he had visited upon the supposed author of the "Mysticètes" of the 'Ostéographie des Cétacés' may well be recalled in the present connection, namely: that there is shown "a very limited knowledge of the subject." It is also regrettable that he did not exhibit "a more philosophic spirit," and manifest a little deference to so high an authority in cetology as Eschricht. His criticism of the *Balæna biscayensis* of the 'Ostéographie,' which, he states, is founded on what appears to him "to be very incongruous materials," is not, however, without point, and his claim that "the only ground on which they are united is that all the specimens were procured from the North Atlantic, together with the preconceived idea that only one whale can inhabit that region," is doubtless to some degree true. After discussing in detail these several fragments, he gives it as his opinion "that there is not at present any material to make out what the *Balæna biscayensis* of Eschricht is, and, that the *Balæna biscayensis* of these authors [Van Beneden and Gervais] is made up of the bones of various whales" (*l. c.*, p. 199).

---

[1] The authorship of the portion of the work which had at this time appeared not having been distinctly announced, Dr. Gray innocently assumed that the author of the part relating to the "Mysticètes" was Gervais, and poured upon him his vials of criticism, made the more sweeping by including in a general way "previous short essays" of this author on the Cetacea, which are referred to as showing a very limited knowledge of the subject. The mistake in respect to authorship, was, however, soon exposed by its avowed author, Van Beneden, as will be presently detailed.

After further reference to "M. Van Beneden's theory of whales inhabiting 'bands across the different oceans,'" he proceeds to enumerate the following five species of "whales of the North Atlantic, including the Mediterranean Sea":

> "1. *Balæna biscayensis*, Eschricht, which, I believe, is a *Cuvierus* with a double-headed first rib [and therefore a Fin-whale, Dr. Monedero's figure of the San Sebastian specimen, and Eschricht's standing as a cetologist to the contrary notwithstanding!].
>
> "2. *Balæna biscayensis*, Van Beneden and Gervais — as distinct from *B. biscayensis* of Eschricht, resting on the mass of cervical vertebræ figured by Lacépède [Dr. Monedero's figure, copied by Van Beneden and Gervais, being again ignored.][1] Whether this is a distinct species or only a variety of *Balæna mysticetus*, there cannot be the slightest doubt of its being distinct from the following.
>
> "3. *Balæna britannica*, Gray, established on the mass of cervical vertebræ which is in the British Museum,. . . .dredged off the coast of Lyme Regis. . . ."

His Nos. 4 and 5 are respectively *Balæna cisarctica* Cope and *Agaphelus gibbosus* Cope (*l. c.*, p. 200), which latter Cope himself afterwards retracted as invalid.

The whales of other seas are reviewed in the course of Dr. Gray's paper, and his critical comment on the way in which some of them are treated, and others ignored, in the work under notice are generally judicious. In the present case, however, enough has been quoted from Dr. Gray's papers touching *Balæna biscayensis* to show that his course in reference to it is, to say the least, strangely inconsistent and unwarranted.

Van Beneden in his reply[2] to Dr. Gray, gave reasons for certain omissions on his map, and for the extension of the range of the Greenland Whale over certain areas, for which he was criticised by Gray. Apropos of the thirteen pairs of ribs in the San Sebastian whale, with the first rib on each side bifid or double-headed, and of fourteen pairs of single-headed ribs in Cope's type of *B. cisarctica*, upon which difference Gray placed great importance, he states that he differs from Gray in respect to the significance of such differences, and proceeds to show that they may be merely individual, and cites examples of this differentiation in other Cetaceans, two of which he illustrates in his accompanying plates.[1] He expresses himself as in perfect accord with Gray when he says that much more material is necessary before we can pronounce definitely upon the geographic distribution of these animals; but that he does not agree with him in considering the species mentioned by him as well established. In view of the great variation due to sex and age, and often to asymmetry, he well says: "On comprendra donc pourquoi diverses baleines qui figurent dans des catalogues n'ont pas été indiquées dans notre notice."

---

[1] On a preceding page (p. 198), in referring to these same vertebræ he says: "At any rate, it [the species they represent] ought to be called *Balæna mediterranea* rather than *biscayensis*, unless", etc.

[2] La première côte des cétacés, à propos de la notice du docteur J.-E. Gray, sur la distribution des baleines. Bull. Acad. roy. de Belgique, 2^e sér., T. XXVI, 1868, pp. 7–17, pll. i, ii.

Contributions and opinions of Paul Fischer, 1871-1881.— In 1871, 1872, and 1881, Prof. Paul Fischer made contributions to the history of the Baleine des Basques. He stated in the first of these papers[2] that he was convinced that the Basque Whale is distinct not only from the Right Whales of the southern hemisphere, but also from *Balæna cisarctica.* The second[3] contains interesting information relative to the history of the Basque Whale-fishery, and a chronological list of the 'Baleines franches' stranded or captured on the coasts of France and the Gulf of Gascony. He refers to Dr. Monedero's drawing of the San Sebastian example as "extrêment précieux parce qu'il constitue la seule representation authentique de la Baleine des Basques," and gives a description of its external characters and a table of measurements — a new and important contribution to the history of the species — with also a detailed account of its capture, from the 'Gazette de Biarritz' of August and September, 1859. He then discusses the question "Existe-t-il plusieurs Baleines franches dans l'océan Atlantique septentrional?" In his 'Résumé' he says: "Les Baleines franches des régions tempérées du Nord Atlantique ont reçu plusieurs noms, suivant les localités où on les a pêchées ou recueillies:

"1° *Balæna Biscayensis,* dans le golfe de Gascogne;
2° *Nordkaper,* en Norwége et Island;

---

[1] In this connection attention may be called to a paper published three years later by William Turner, entitled 'On the so-called Two-headed Ribs in Whales and in Man' (Journ. Anat. and Phys., V, May, 1871, pp. 348–361, figs. 1–3), in which he says: "This anatomical peculiarity has been regarded by some systematic zoologists, more especially by Dr. J. E. Gray of the British Museum, as a character of so much importance that it has been made a basis for classification. Dr. Gray has separated those skeletons of the whalebone whales in which this condition of the first rib has been seen from the species with which they might in other respects have been associated, and erected them, not merely into distinct species, but even into new genera" (*l. c.*, p. 348). In illustration of this he cites Gray's genera *Sibbaldus* and *Hunterus.* After reviewing the "facts and opinions which have been collected and advanced by previous writers," and adding "some new facts and observations" of his own, he presented a series of propositions which he considered as firmly established, in part as follows: "1st. In the cetacea cervical ribs are not unfrequently developed in connection with the 7th vertebra. 2nd. The cervical ribs may remain free, or may become permanently blended with the 1st thoracic rib. . . . .4th. The bifurcated form of the rib is due, not to the subdivision of a single bone into two parts, but to the fusion of two bones into one mass, the vertebral extremity of which continues to exhibit its fundamental duplex character" (*l. c.*, p. 354).

[2] Sur la baleine des Basques (*Balæna Biscayensis*). Compt. rend. Acad. Sci. Paris, LXXII, 1871, pp. 298–300.

[3] Documents pour servir à l'histoire de la baleine des Basques (*Balæna Biscayensis*). Ann. des Sci. nat., 5e sér., XV, 1872, art. No. 3, pp. 1–20.

3° Baleines de *Sardes* ou Sardes, au banc de Terre-Neuve;
4° *Balæna cisarctica,* sur les côtes E. de l'Amérique du Nord;
5° *Hunterius Svedenborgi,* subfossile de Gothland;
6° *Balæna Lamanoni,* subfossile de Paris. [To which he should have added *Balæna britannica* Gray, Lyme Regis.]

"Ces désignations," he continues, "s'appliquent-elles à une seule espèce? Je ne le pense pas, malgré l'opinion de leur identité presentée par M. Van Beneden." After a brief discussion of their characters he reaches the conclusion that there are at least two species of Right Whales in the temperate regions of the North Atlantic, neither of which has any relation to the Greenland Right Whale, *Balæna mysticetus.*

Ten years later, in 1881, in another memoir on the Cetacea of the southwest coast of France,[1] he again discussed the number of species and relations of the whales of the Nordkaper group, "propres à l'Atlantique du Nord, ou récemment fossilisées en Europe," of which he enumerates 12 that have received names. All the living species are now referred to *Balæna biscayensis,* but he believes that *Balæna cisarctica* (to which he refers the Sarde), should, until better known, be regarded as at least a distinct subspecies from *B. biscayensis.* The fossil species he regards as not sufficiently known to be classified. Among the additional information of interest relating to the Basque Whale may be noted the publication of Segnette's original description ("en mauvais latin") and measurements of an individual stranded on Ile de Ré, in February, 1680.

As Fischer's papers have been summarized at length and critically reviewed by True,[2] it is unnecessary to give them further space in the present connection.

Balæna tarentina Capellini.— On the 9th of February, 1877, a Right Whale was taken in the Gulf of Taranto, in the Mediterranean, the first specimen known to have been taken in Mediterranean waters. The specimen, a young female 12 meters in length, was described and figured by Professor G. Capellini[3] of Bologna under the name *Balæna tarentina.* It was compared with Dr. Monedero's figure of the San Sebastian whale, from which it differed in the form of the head and pectoral fins. The skeleton passed into the possession of the University of Naples, and later in the same year became the subject of a paper by Dr. Francesco Gasco.

Gasco, 1877–1879.— Dr. Gasco,[4] in his memoir on this specimen, states: "A careful examination of the osteological characters, soon showed me that the whale of Tarento was identical with that captured in 1862 in Delaware Bay opposite Philadelphia, and upon which Mr. E. [D.] Cope published a very brief osteological report in the year 1865. Both the Tarento whale and that of Philadelphia belong to the species *Balæna biscayensis*, Eschricht, which for several centuries was pursued with avidity, and, I was going to say, exterminated, throughout the temperate region of the North Atlantic, first by the Basques, and then successively by the Saintongeois, the Normans, the Dutch (who called it Nordkaper), the Danes, Norwegians, English, and Americans." [1]

---

[1] Cétacés du Sud-Ouest de la France. Actes Soc. Linn. de Bordeaux, XXXV, 1881, pp. 5–220, pll. i–viii. Also separate.

[2] The Whalebone Whales of the Western North Atlantic, 1904, pp. 264–267.

[3] Della Balena di Taranto, confrontata con quella della Nuove Zelanda e con talune fossili del Belgio e della Toscana. Mem. R. Accad. Sci. Bologna (3), VIII, 1877, pp. 3–32, pll. i–iii. Also separate, 1877, pp. 1–34, pll. i–iii.

[4] Intorna alla balena presa in Taranto nel Febbrajo, 1877. Atti Roy. Accad. Sci. Napoli, VII, No. 16, 1878, pp. 1–47, pll. i–ix. Also separate, same date and collation.

In 1879, Dr. Gasco gave also a detailed description of the skeleton of the San Sebastian Whale,[2] just a quarter of a century after the capture of the animal, and after it had rested twenty-one years in the Museum of Copenhagen. Of the thirty-six pages occupied by this memoir ten are devoted to a historical summary of the so-called "*Balæna biscayensis*, Eschricht," six to the history and external characters of the San Sebastian specimen, and the remaining twenty to its osteology. Dr. Gasco gave the number of pairs of ribs as thirteen (not fifteen as stated by Gray and Fischer), and described the bifidity of the first rib as very slight, the sinus amounting to 55 mm. in the left and only 15 mm. in the right. This slight bifidity, he conjectured, might at a later stage of life, have become much lessened or have wholly disappeared. He affirmed the unquestionable specific identity of the San Sebastian and Taranto whales, and quotes a statement made to him verbally by Professor Cope, after the latter had seen the Taranto specimen, to the effect that this agreed exactly with the Philadelphia specimen described by him under the name *Balæna cisarctica*. Although there was previously every probability in favor of this conclusion, this may be reasonably taken as negatively settling the conjectures of the specific diversity of *B. biscayensis* and *B. cisarctica* raised by Gray and Fisher. Also that the bifidity of the first rib, which had for a decade figured so prominently in the references to this specimen, and had been accorded so much importance in the writings of Gray, Fischer, and others, is in all probability only an individual peculiarity, such as is often met with in the skeletons of many well-known animals.[3]

Holder, 1883.— In 1883, the late Dr. J. B. Holder, curator of Zoölogy at this Museum, published an important contribution to the technical history of the North Atlantic Right Whale, based on American specimens. This paper [1] includes, first, a summary of the late Prof. E. D. Cope's account of the osteological characters of the type of his *Balæna cisarctica*, published in 1865, based on a young specimen from Delaware Bay. This is followed by an account of the capture, January 7, 1880, of a specimen in the harbor of Charleston, S. C., also a young example, with a brief description and measurements of the skeleton, preserved in the Charleston Museum, contributed, with a drawing of the skull, by the late Dr. G. E. Manigault, then curator of the Charleston Museum. There is next a short account of the external characters of a specimen captured off the coast of New Jersey in the spring of 1882, with measurements and a figure (side view of animal) drawn by Dr. Holder, with details of the head and tail, taken from photographs made by the well-known animal artist, D. C. Beard.[2] Then follows a detailed account of the osteology of the skeleton in this Museum, taken on the south shore of Long Island, N. Y., probably prior to 1875, with a figure of the skeleton. Following this are several pages of doubtfully pertinent references to whales formerly seen in the Gulf of St. Lawrence.[3]

---

[1] From a summary of his conclusions, entitled 'La *Balæna* (*Macleayius*) *australiensis* du Musée de Paris, comparée à la *Balæna biscayensis* de l'Université de Naples,' published in Compt. rend. Acad. Sci. Paris, LXXXVII, Sept. 9, 1878, pp. 410–412, as translated and republished in Ann. and Mag. Nat. Hist., 5th ser., II, Dec., 1878, pp. 495–497.

Van Beneden, in commenting on a letter received by him from Capellini, 'Un mot sur une Baleine capturée dans la Méditerranée, in Bull. Acad. roy. de Belgique, 2e sér., XLIII, 1877, pp. 741–745), also referred Capellini's *Balæna tarentina* to *B. biscayensis*.

[2] Il Balenotta catturato nel 1854 a San Sebastiano (Spagna) (*Balæna biscayensis*, Eschricht) per la prima volta descritto dal Dr. Francesco Gasco, Professore di Zoologia e Anatomia comparata nella R. Università di Genova. Ann. del Mus. civ. di stor. nat. di Genova, XIV, 1879, pp. 573–608.

[3] *Cf.* footnote on p. 298.

These specimens are all referred to *Balæna cisarctica* Cope, the identity of which with "*B. biscayensis* Eschricht" the author considers as "now pretty well established." Its relations to other species are considered, following which is a concise summary of the history of the Right Whales of the North Atlantic (pp. 120–133), chiefly in respect to their synonymy and relationships. This paper, although somewhat crude, is the foundation of our scientific knowledge of the Right Whale of the North Atlantic coast of North America.

Flower, 1864–1891.— A publication which has had much influence with British zoölogists is the late Sir William Henry Flower's 'List of the Specimens of Cetacea in the Zoological Department of the British Museum,' published in 1885.[4] His views, as here expressed, differ widely from those held by him in 1864–1869 respecting the number of genera and species of Right Whales. Instead of the recognition of two genera (*Balæna* and *Eubalæna*) and several species, as in 1864,[5] only two are recognized, both of which are referred to the genus *Balæna*, namely, (1) *B. mysticetus* Linn., and (2)

---

[1] The Atlantic Right Whales: A Contribution, embracing an examination of I. The exterior characters and osteology of a cisarctic Right Whale — male. II. The exterior characters of a cisarctic Right Whale — female. III. The exterior characters of a cisarctic Right Whale — sex not known. To which is added a concise résumé of historical mention relating to the present and allied species, By Joseph Bassett Holder. Bull. Amer. Mus. Nat. Hist., I, No. 4, pp. 99–137, pll. x-xiii. May, 1883.

[2] In this connection attention may be called to the sketches of a whale captured February 23, 1897, at Amagansett, Long Island, N. Y., made by Mr. Beard and published in his 'Dan Beard's Animal Book' (New York, Moffat, Yard & Co., 1907), p. 213 (animal, in profile and front-views, etc.), p. 219 (diagrams of animal), and p. 222 (photograph of parasites, from life).

[3] *Cf.* Allen, Science, 1st ser., I, pp. 598, 599, June 29, 1883. Also Holder and Allen, *ibid.*, II, pp. 132–134, and 266, 267.

[4] 8vo, pp. vi + 36.

[5] Proc. Zool. Soc. London, 1864, pp. 389–391; Trans. Zool. Soc. London, VI, 1869, p. 115.

B. australis Desm. To the latter are apparently referred not only all of the existing species of Right Whales except the Arctic or Greenland Right Whale, but several fossil species, including Gray's *Macleayius britannicus*[1] or, as called later, *Halibalæna britannica*,[2] from the Lyme Regis of England. This extreme conservatism also characterized his notice of this group of animals in 1891,[3] where of *Balæna australis* it is said: "This form inhabits the temperate seas of both northern and southern hemispheres, and is divided into several so-called species according to their geographical distribution: — *B. biscayensis* of the North Atlantic, *B. japonica* of the North Pacific, *B. australis* of the South Atlantic, and *B. antipodarum* and *B. novæ-zelandiæ* of the South Pacific" (*l. c.*, p. 239). This view is perhaps naturally reflected in the writings of later British compilers of popular works on natural history, although in opposition to the opinion of all modern cetological authorities.

Contributions of Guldberg, 1884–1893.— In 1884, G. A. Guldberg published a note[4] on the former distribution and migrations of "*Balæna biscayensis* Eschricht," announcing the discovery by him of its bones on the shores of Finmark, left there by the Dutch whalers of the sixteenth century, and of evidence of its reappearance in numbers along the coast of Norway; and also a more extended paper on the same subject,[5] in which part of a skull and various other bones, found on a small island off the coast of Finmark, are described. A further contribution was made by this author in 1891,[6] giving an account of specimens captured during the nineteenth century, including new records for Norway (1889) and Iceland (1890, 1891), and measurements, etc., based on this new material. An article of twenty pages by the same author also appeared in 1893,[7] containing about eight pages of historical observations, followed by descriptions and figures (the latter from photographs received from Captain M. Berg) of the external characters (pl. i), and an account of its osteology, including the pelvic bones and pelvic limb (pl. ii), based on Iceland specimens. *Eubalæna* is recognized as generically distinct from *Balæna*, with four species: (1) *E. biscayensis*, of the North Atlantic; (2) *E. australis*, of the South Atlantic; (3) *E. japonica*, of the North Pacific; and (4) *E. antipodarum*, of the South Pacific (*l. c.*, p. 18).

Van Beneden, 1885.— In 1885, Van Beneden, in a paper on the Cetacea of the European seas,[1] recorded the capture of a specimen of the Basque Whale on the coast of Spain, between Guettaria and Zaraux, February 3, 1878.

---

[1] Ann. and Mag. Nat. Hist., 4th ser., VI, 1870, p. 204.

[2] Gray, Proc. Zool. Soc. London, 1873, pp. 140–142, fig. 5.

[3] Mammals, Living and Extinct. By William Henry Flower and Richard Lydekker. 8vo. London, 1891.

[4] Nature, XXX, 1884, pp. 148, 149.

[5] Sur la présence, aux temps anciens et modernes, de la Baleine de Biscaye (ou Nordkaper) sur les côtes de Norwège. Bull. Acad. roy. de Belgique, 3e sér., VII, 1884, pp. 374–402.

[6] Bidrag til nœiere kunskab om Atlanterhavets rethval, *Eubalæna biscayensis*, Eschricht. Christiania Vidensk.-Selsk. Forhandl., 1891, No. 8, pp. 1–14.

[7] Zur Kenntniss des Nordkapers. (*Eubalæna biscayensis* Eschr.). Zool. Jahrb., Abth. für Syst., VII, May 20, 1893, pp. 1–20, pll. i and ii.

Graells, 1889.— In 1889 appeared an important paper by M. P. Graells, on the whales of the Atlantic coast of Spain,[2] which contains much new matter of historical interest relating to "*Balæna biscayensis* Eschricht," to which the paper mainly relates. It contains measurements and figures of the Guettaria specimen, mentioned above, now for the first time described. The figures accompanying this paper are not only inartistic, but the author states that they are inaccurate, which may explain the discrepancies between them and Gasco's based on photographs.[3]

Jouan, 1890.— In 1890, Henri Jouan published an account of the whales, seen or captured on the coast of France,[4] which contains a list of the occurrences of the Basque Whale on the French and neighboring coasts for about two centuries. These are: (1) an adult female, stranded or captured on Isle de Ré in 1680,— not preserved but measurements were taken and made available by Fischer in 1881 (republished from Segnette); (2) a female and young in the harbor of San Sebastian, Jan. 14, 1854 — the young one captured and its skeleton later transferred to Copenhagen and studied by Eschricht, but first fully described by Gasco in 1879; (3) a specimen reported as taken at San Sebastian Jan. 11, 1878; (4) a young female taken near Taranto, in the Mediterranean, Feb. 9, 1877, the skeleton of which was preserved, and described by Capallini as *Balæna tarentina,* and redescribed later by Gasco and referred by him to *B. biscayensis*; (5) a specimen embayed early in November, 1881, near Fontarabie, in the western end of the Mediterranean, and though attacked by fishermen finally escaped to the open sea; (6) a specimen, supposed to represent this species, seen but not taken, Dec. 24, 1887, near San Sebastian; (7) two seen and one taken by fishermen near Algiers, in the western part of the Mediterranean, in February or March, 1888; to which should apparently be added (8) the Guettaria specimen, taken Feb. 3, 1878, and its skeleton preserved in a museum at San Sebastian and described by Graells in 1889. These eight supposed instances resulted in the preservation of three skeletons and the external measurements of another specimen.

Ridewood, on the structure of the 'Bonnet,' 1901.— A paper by W. G. Ridewood, published in 1901,[5] on the structure and origin of the 'bonnet' in the "Southern Right Whale," is chiefly of interest as a histological contribution, based on a specimen of uncertain origin, by perhaps a good histologist, but one strangely ignorant of the well-known function of this structure, as the nidus of parasitic crustaceans, by which its growth is promoted, if not originally caused, instead of being due to the failure of the cornified layers of the skin "to rub off at their normal rate, but remain and accumulate to produce a hard mass, projecting above the general surface of the epidermis as a kind of corn" (!).

---

[1] Les Cétacés des Mers d'Europe. Bull. Acad. roy. de Belgique, 3e sér., X, 1885, pp. 707–732.

[2] Las Ballenas en las Costas oceanicas de Espana. Mem. Real. Acad. de Cienc. de Madrid, XIII, pt. 3, 1889, pp. 1–115, pll. i-ix.

[3] *Cf.* True Whalebone Whales of the Western North Atlantic, p. 252.

[4] Apparition des Cétacés sur les côtes de France. Bull. Soc. Linn. de Normandie, 4e sér., IV, 1890, pp. 137–164.

[5] On the Structure of the Horny Excrescence, known as the "Bonnet," of the Southern Right Whale (*Balæna australis*). Proc. Zool. Soc. London, 1901, pp. 44–47, pl. vi.

True, 1904.— A most important recent contribution to the history of the North Atlantic Right Whale is contained in True's 'Whalebone Whales of the Western North Atlantic.'[1] The references, however, to its general history are somewhat scattered, occurring *passim* under the following captions: 'Chapter I. The earliest references to Whalebone Whales in American Waters' (pp. 6–33). 'Chapter II, A chronological account of important contributions to the natural history of North American Whalebone Whales' (pp. 34–77). In these chapters the North Atlantic Right Whale is mentioned informally, or incidentally, in connection with other species of Whalebone Whales, in copious extracts from original sources, for the most part in chronological sequence. In 'Chapter III. A review of Cope's and Scammom's Species' (pp. 78–106), an account is given (pp. 79, 80) of Cope's *Balæna cisarctica,* based on the type specimen in the museum of the Philadelphia Academy of Natural Sciences. Chapter VIII (pp. 244–268) is devoted entirely to 'The North Atlantic Right Whale, *Balæna glacialis* Bonnaterre.' In Chapter X, a concise description of *Balæna glacialis* occupies fifteen lines on p. 298. Five plates (42 to 46, inclusive), from photographs, are devoted to illustrations of this species, and include the skull of a Long Island specimen (dorsal, lateral, and ventral views, pll. 42 and 43); two views of the skull of the Charleston specimen (pll. 43 and 45); a side view of the type skeleton of *Balæna cisarctica* Cope (pl. 44); the left scapula of four different skeletons (pl. 45); head and side view of a specimen in the flesh, taken at Provincetown, Mass., and two sternums (pl. 46). The text figures illustrate the nasal bones of the type of *B. cisarctica* (fig. 84, p. 252); the sternums of the Taranto, of an Iceland, and of a Long Island specimen,[2] showing wide differences of form (fig. 85–87, p. 258); six scapulæ, representing five American specimens and the Taranto specimen (figs. 88–93, p. 259).

---

[1] The Whalebone Whales of the Western North Atlantic, compared with those occurring in European Waters, with some observations on the species of the North Pacific. By Frederick W. True, Head Curator, Department of Biology, United States National Museum. Smithsonian Contributions to Knowledge, Vol. XXXIII, 1904.— 4to, pp. vii + 332, pll. i–l, and 97 text figures.

[2] The sternum of the Long Island specimen is a restoration, wrongly modeled from the sternum of a Rorqual.

The text contains an exhaustive summary of all the published accounts of the external and osteological characters of all the then known specimens, both European and American, and much original matter relating to several American examples not previously described. Under the headings, 'size,' 'external proportions,' 'color,' and 'osteological characters,' detailed comparisons are made between European and American specimens, with numerous tables of comparative measurements of the total length in the flesh, of the skeleton, skull, and various individual bones. His conclusions are summarized in ten propositions, with the final statement: "While there are many points regarding the Nordcaper that need to be further investigated, there is at present, so far as can be ascertained from the material available, no valid reason for separating the American from the European specimens as distinct species" (p. 262). He then devotes several pages (pp. 262–267) to a consideration of the "opinions regarding the identity of the Right Whales of the Eastern and Western Atlantic" advanced by cetologists, or the relationship of *Balæna biscayensis* to *B. cisarctica*, from Zorgdrager and Martens down to Van Beneden, Holder, Guldberg, and other late writers. He fails, however, to notice the attitude of Flower on the question of the relation of the North Atlantic Right Whale to the Right Whales of the North Pacific and the southern hemisphere, although his opinion has dominated later British authors who have written of these whales. In his Chapter XI, 'Whalebone Whales of the Eastern North Pacific Ocean,' True treats briefly of the Right Whales of the Northwest Coast, under the name "*Balæna sieboldii* Gray (?)," basing his notice, in lack of additional material, on Scammon's account of it, and closes by quoting, without comment, Van Beneden's strongly expressed conviction that the Right Whale of the North Pacific is a distinct species from that of the North Atlantic.

Andrews, 1908.— Only one other contribution to the history of the North Atlantic Right Whale will be mentioned in the present connection,— a notice by Roy C. Andrews of two specimens[1] captured on the coast of Long Island, New York, February 22, 1907, and secured for this Museum, through the liberality of Mr. Geo. S. Bowdoin of this city. As the preparation of these specimens for shipment to the Museum was made under the superintendence of Mr. Andrews, he fortunately had opportunity to take notes and measurements of the animals while in the flesh, and later to study the skeletons of both animals at the Museum. His paper, as the title indicates, relates to the external and internal anatomy of these specimens, which were both females, one of them an old and very large individual, the other about two thirds grown. In addition to detailed measurements of the external parts, and of the skull and various other portions of the skeleton, much information is given regarding the vertebral column, pectoral limb, sturnum, scapula, vertebræ, etc., which parts are illustrated by text figures. There is also a figure of a model[1] of the adult specimen, carefully made from the animal by James L. Clark, animal modeler at this Museum, which is doubtless the most accurate representation of the external form of this species yet published.

---

[1] Notes on the External and Internal Anatomy of *Balæna glacialis* Bonn. Bull. Amer. Mus. Nat. Hist., Vol. XXIV, 1908, pp. 171–182, figs. 1–6.

III.— RELATIONSHIPS AND NOMENCLATURE.

Relationships.— As already shown (*antea*, pp. 281–288) the whalers of the early part of the seventeenth century recognized the Arctic or Greenland Right Whale, when they first met with it in the Spitzbergen seas, as a very different animal from the Right Whale that for several centuries had been the foundation of the whale-fishery of the temperate North Atlantic, and it was on the basis their crude comparisons of the two species in the annals of their craft that they were recognized as distinct by the systematists of the eighteenth century. Later, however, Cuvier united them as a single species, owing to the absence of specimens of the more southern form, and influenced largely by the opinion of Scoresby (see *antea*, p. 289), whose personal knowledge of the subject was confined to the Right Whale of the Arctic seas. Eschricht, from his study of the literature became convinced that the North Atlantic and the Greenland animals not only differed widely in their general conformation, but occupied distinct geographic areas. He had not then seen a specimen of the North Atlantic species, and when he later had opportunity to study the now famous San Sebastian specimen, he was able to announce that it not only represented a species distinct from the Greenland Whale, but one that was not at all nearly related to it, it much more closely resembling *Balæna australis* of the southern hemisphere. Unfortunately the publication of his memoir on this specimen was prevented by his death, and the osteological characters of the species remained undescribed till nearly twenty years later, when a second representative of it was captured in the Mediterranean, and its external and osteological characters were described and illustrated by Capellini in 1877 and by Gasco in 1878. In the meantime, however, it had received wide recognition in the literature of zoölogy under the name *Balæna biscayensis*.

In 1864, J. E. Gray[2] proposed to separate the Right Whales into two generic groups, retaining in *Balæna* only *B. mysticetus* Linn., and founding his new genus *Eubalæna* on *B. australis* Desm. He was unable to satisfactorily identify *B. biscayensis*, which later he regarded it as having no "zoölogical basis," and still later referred it to his genus *Hunterus*, after having also considered it as probably not separable from *B. mysticetus*.

---

[1] The scale given in the title to this illustration, "1 inch to 1 foot," relates to the model and not to the animal. The model is about $\frac{1}{11}$ natural size (linear).

[2] Proc. Zoöl. Soc. London, 1864, pp. 199–201.

These two groups have been recognized by various authors as well founded, as by Flower (in 1864 and 1869), Van Beneden, and Guldberg, and by the latter adopted as a full genus. They may be diagnostically contrasted as follows:[1]

Balæna.— Head and body enormously thick in proportion to the length, with the head forming about one third of the total length; skull greatly arched, thus affording space for the long baleen, which differs much in texture as well as length from that of the whales of the *Eubalæna* group.

Eubalæna.— Head and body relatively long and slender, with the head forming about one fourth of the total length; skull much less arched, and the baleen about one half shorter than in *Balæna*, and also much thicker, not so smooth, and with a coarser fringe.

The total length is nearly the same in both *B. mysticetus* and *E. glacialis* (= *Balæna biscayensis* auct.), but the bulk of the former is enormously greater than in the latter, especially of the head, which results in great difference in external proportions, and in the structural details of the skull. The other Right Whales (excepting of course the genera *Neobalæna* and *Rhachianectes*) closely resemble the North Atlantic species, but the North Pacific Right Whale is apparently larger with longer baleen.

Eubalæna *Gray.*

Eubalæna Gray, P. Z. S., 1864, 201, 589; Ann. and Mag. Nat. Hist. (3), XIV, 1864, 348; Cat. Seals and Whales, 1866, 91; Synop. Whales and Dolphins, 1868, 1; Suppl. Cat. Seals and Whales, 1871, 42.— Flower, P. Z. S., 1864, 390; Trans. Zool. Soc. London, VI, 1869, 115.— Van Beneden & Gervais, Ostéogr. des Cétacés, livr. 4, 1868, 114 (in text).— Lilljeborg, Nov. Acta Reg. Soc. Sc. Upsala (3), VI, 1867, 14.— Guldberg, Christiania Vidensk.-Selsk. Forhandl.. 1891, No. 8, 12; Zool. Jahrb., Abth. f. Syst., VII, 1893, 18.

Monotypic, with *Balæna australis* Desmoulins as type.

Four species of *Eubalæna* are commonly admitted by cetologists, and seem to be fairly well founded. Two occur in the northern hemisphere and two (possibly three) in the southern hemisphere. Those of the northern hemisphere are separated from those of the southern hemisphere by a broad belt of tropical and subtropical waters, covering not less than fifty degrees of latitude; the species of the two hemispheres are not only restricted to temperate latitudes, but are also absent from the Arctic and Antarctic seas. On the other hand, the home of *B. mysticetus* is the icy waters of the Arctic regions, it moving southward in winter on the closing of its summer haunts by compact ice; it has also no representative in the Antarctic seas. The species of *Eubalæna* are likewise migratory, moving toward warmer latitudes with the approach of winter, and seeking colder latitudes with the return of the warmer season.

---

[1] In this connection reference may be made to the four genera proposed by Eschricht in 1849 (Kong. Danske Vidensk. Selsk. Skr., 5th ser., naturv. og math. Afd., I, 1849, p. 108) for the species of whalebone whales as then known, all of which he placed in a comprehensive group *Balæna*, dividing it into two primary divisions, *Liobalæna* (Right Whales), and *Ogmobalæna* (Humpback and Finback Whales). The latter he further divided into *Kyphobalæna* (Humpbacks = *Megaptera* Gray, 1846), and *Pterobalæna* (Finbacks = *Balænoptera* Lacépède, 1804). His *Liobalæna* was, as here defined, the same as the *Balæna* sensu stricta of authors, and, no type being designated, must be regarded as a synonym of *Balæna*.

It is, indeed, physically impossible for the Right Whales of the north temperate zone to visit the south temperate zone, or those of the latter to visit the former. As shown by Lieut. H. M. Maury,[1] on evidence that has never been refuted nor seriously contested, the torrid zone is "forbidden ground" for the right whale; " . . . .and that it is physically as impossible for him to cross the equator as it would be to cross a sea of flame. In short, these researches show that there is a belt from two to three thousand miles in breadth, and reaching from one side of the ocean to the other, in which the right whales are never found" (*l. c.*, p. 253). As this condition has continued for ages, it is seemingly unnecessary to institute a detailed comparison between the Right Whale of the North Atlantic and its congeners of the southern seas. Yet a comparatively recent English authority of note (Flower, see *antea*, p. 301) has lumped them altogether as one species under the name *Balæna australis*. This strange conservatism is still maintained by British authors, as Lydekker,[2] Beddard[3] and Millais,[4] in their recent popular accounts of these animals, in spite of the fact that all modern zoögeographic knowledge of the conditions which govern the geographic distribution of animals is utterly opposed to such a conclusion. The case is somewhat different with the Right Whale of the North Pacific, in respect to its relation to its congener of the North Atlantic. They have their ranges separated, not by tropical waters, but in part by the icy barrier of the Arctic seas, and in part by immense continental areas; there is also evidence of well-marked diversity in size and other characters, although the North Pacific species is scientifically very little known.

Nomenclature.— As already shown (*antea*, p. 288), the Right Whale of the North Atlantic was provided with names by the early systematists, as by Klein (1741), who called it *Balæna glacialis, c. borealis*, and by Brisson (1756), who named it *Balæna islandica*, but as both of these authors are pre-Linnæan, their names are not open to consideration. Bonnaterre, in 1789, named it *Balæna glacialis*; his name, based on the Nordkaper of previous authors, is shown by his description and references to be clearly applicable to the present species: Lacépède, in 1804, renamed it *Balæna nordcaper*, with primarily the same basis. Many years later (1864), J. E. Gray applied the name *Balæna biscayensis* to the San Sebastian specimen, apparently inadvertently, through giving a Latin rendering of Eschricht's 'Baleine de Basques,' since he ascribed it to Eschricht, and the species has passed, as already shown at length (*antea*, p. 291), into literature as "*Balæna biscayensis* Eschricht." The following year, Cope described an American specimen of what is considered to be the same species under the name *Balæna cisarctica*, in the belief that *B. biscayensis* had not been properly founded. In 1877, another synonym, *Balæna tarentina*, was added by Capellini, on the basis of a straggler taken in the Bay of Taranto in the Mediterranean. Other late names have been based on fossil fragments believed to be also referable to the same species. These, owing to their late origin, do not require consideration as possible substitutes for *B. glacialis* Lacépède.

---

[1] Sailing Directions, 7th ed., 1855, p. 253.
[2] Royal Natural History, Vol. III, sect. 5, 1895, p. 12.
[3] A Book of Whales, 1900, p. 133.
[4] Mammals of Great Britain and Ireland, Vol. III, 1906, pp. 224–231.

In this connection it is necessary to consider briefly the question of the possible specific distinctness of the Right Whales of the two sides of the North Atlantic. Unfortunately the skeletons of only three specimens from the European coasts have ever been secured, all young animals (the Iceland specimens are of course not pertinent), and no American example has been available in Europe for direct comparison with any of them. It has been generally conceded, however, for many years that no satisfactory differences are apparent on which it is safe to separate specifically the American and European examples. Mr. True, in his 'Whalebone Whales of the Western North Atlantic,' published in 1904, has most carefully brought together all available data bearing on this question, which he has presented and discussed with great fairness. His conclusions confirm those of previous investigators, and for the present there seems to be no alternative but to give them full acceptance, namely, that "there is at present....no valid reason for separating the American from the European specimens as distinct species" (*l. c.*, p. 262). To him also belongs the credit of reviving the name *Balæna glacialis* of Bonnaterre as the correct name for the species.[1]

From this point of view the synonymy and principal references to this species may be given as follows:

---

[1] I had reached the same conclusion in 1881, as shown by the following transcript of the closing lines of my discussion of the nomenclature of the species: "If the practice of substituting the earliest names that can be identified in the light of present knowledge for others of later date that have become familiar through long use, now so rife, is to be followed, there is no question as to the tenability of Bonnaterre's name, which, sooner or later, some one will revive, in view of which we reluctantly now adopt it." — *MS.*

Eubalæna glacialis *Bonnaterre.*

NORTH ATLANTIC RIGHT WHALE.

Sarda EDGE, Purchas his Pilgrims, III, 1625, 471, 710.— FISCHER, Actes Soc. Linn. de Bordeaux, XXXV, 1881, 41–45.

Sletbag (of the Icelanders), *cf.* ESCHRICHT & REINHARDT, Ray Society Memoirs on Recent Cetacea, 1866, 32–33.

Die Nord-Kaper Wallfisch MARTENS, Spitzb. oder Groenland. Reise-Beschreib., 1675, 106.

Whale of the North Cape MARTENS, Account of several late Voy. and Disc., London, 1711, [pt. ii], 151.

Noortkaper ZORGDRAGER, Bloeyende Opkomst der Aloude Hedendaagsche Groenl. Visschery, 1720, 91.

Right or Whalebone Whale DUDLEY, Phil. Trans., XXXIII, 1726, 256.

Nordkapper EGEDE, Det Gamle Gronlands Nye Perlust., etc., 1741, 40.— ANDERSON, Nachrichten von Island, Grönland, und der Strasse Davis, 1746.— FISCHER, Actes Soc. Linn. de Bordeaux, XXXV, 1881, 36–40.

Nord-Caper CRANZ, Hist. Groenland, 1765, 145.

Baleine d' Islande BRISSON, Reg. anim., 1756, 350.

Black Whale; *True Whale*; *Whalebone Whale*, Early New England Whalers (*cf.* DOUGLASS, Summary, Hist. and Polit., Brit. Settlem., I, 1760, 56.

Seven feet bone Whale ST. JOHN DE CREVECŒUR, Letters from an American Farmer, 1782, 169.

Atlantic Right Whale SOUTHWELL, Seals and Whales of British Seas, 1881, 61–69.

North Atlantic Right Whale ALLEN, Science (1), I, 1883, 598, 599; II, 1883, 134, 267 (review of Holder's paper).

Balæna glacialis, c. borealis KLEIN, Hist. Pisc. Nat., Miss. ii, 1741, 12 (ex Zorgdrager). *Cf.* FISCHER, Actes Soc. Linn. de Bordeaux, XXXV, 1881, 40.

Balæna islandica BRISSON, Reg. anim., 1756, 350 (ex Klein, Anderson, etc.).— TIEDEMANN, Zool., 1808, 571.— DEWHURST, Nat. Hist. Cetacea, 1834, 86–91.

Balæna mysticetus islandica KERR, Anim. Kingd., I, 1792, 357.

Balæna glacialis BONNATERRE, Cetologie, 1789, 3 (ex Klein, Brisson, Anderson, etc.). — VIREY, Nouv. Dict. Sci. nat., III, 1816, 183–185.— CUVIER, Règne anim., I, 1817, 286.— [MILLAR], Encyc. Brit., 5th ed., V, 1817, 330.— DESMAREST, Mamm., 1822, 527.— DESMOULINS, Dict. class. d'Hist. nat., II, 1822, 161.— HARLAN, Faun. Amer., 1825, 297.— LESSON, Man. de Mamm., 1827, 425.— ALLEN, 1881, MSS.— TRUE, Whalebone Whales West. N. Atlantic, 1904, 245–268, 298, pll. xlii–xlvi (summary of present knowledge, with comparison of all European and American descriptions, and much new material described and figured).— ANDREWS, Bull. Amer. Mus. Nat. Hist., XXIV, 171–182, figs. 1–6 (new material described and figured).

Balæna glacialis β. GMELIN, Syst. Nat., I, 1788, 223 (ex Brisson, Klein, etc.).— G[ERADIN], Dict. Sci. Nat., III, 1816, 438.

Balæna nordcaper LACÉPÈDE, Hist. nat. des Cétacés, 1804, 103–110 (part), based on Klein, Anderson, Brisson, etc.).— SONNINI, Buffon's Hist. nat., nouv. éd., Cétacés, 180–188 (part).

Balæna mysticetus (not of Linnæus), most authors prior to 1860 (in part).— GRAY, Cat. Seals and Whales, 1866, 81–88 (in part).

Baleine franche du golfe de Biscaye Eschricht, Compt. rend. Acad. Sci. Paris, L. 1860, 224.

Baleine de Biscaye Eschricht, in Van Beneden & Gervais, Ostéogr. des Cétacés, livr. 4, 1868, 98.

Balæna biscayensis Gray, P. Z. S., 1864, 201 (an incidental reference to the "Right Whale of the Bay of Biscay, Eschricht"); Cat. Seals and Whales, 1866, 89 (ex Eschricht, as above, without description); Ann. and Mag. Nat. Hist. (4), I, 1868, 244; *ibid.*, VI, 1870, 200, 391.— Flower, P. Z. S., 1864, 394 (also referred to *Eubalæna*, the specific name being ascribed to Eschricht).— Van Beneden, Bull. Acad. roy. de Belgique (2), XXV, 1868, 15, 16; Ostéogr. des Cétacés, livr. 4, 1868, 90–110, pl. vii (at least mainly); Bull. Acad. roy. de Belgique (2), XXVI, 1868, 7–17 (passim); *ibid.* (2), XLIII, 1877, 741–745; *ibid.* (2), XLIX, 1880, 313–315; *ibid.* (3), IV, 1882, 407–414; *ibid.* (3), X, 1885, 212–214 (occurrence on coast of United States), 709, 710 (and Norway).— Fischer, Compt. rend. Acad. Sci. Paris, LXXII, 1871, 298–300 (historical and systematic); Ann. des Sci. nat. (5), XV, 1872, 1–20 (chiefly historical); Actes Soc. Linn. de Bordeaux, XXXV, 1881, 5–220, pll. i–viii (historical and systematic).— Gasco, Atti roy. Accad. Sci. Napoli, VII, 1878, 1–47, pll. i–ix (descrip. of Taranto specimen); Compt. rend. Acad. Sci. Paris, LXXXVII, 1878, 410–412 (on various bones from coast of Finmark); Ann. and Mag. Nat. Hist. (5), II, Dec. 1878, 495–497 (translation of the last); Ann. Mus. civ. di stor. nat. Genova, XIV, 1879, 573–608 (first account of osteol. of San Sebastian specimen).— Markham, P. Z. S., 1881, 969–976 (early Basque whale-fishery); Nature, XXV, 1882, 365–368.— Giglioli, Nature, XXV, 1882, 505 (reference to the Taranto specimen).— Holder, Bull. Amer. Mus. Nat. Hist., I, No. 4, May, 1883, 117–120, pll. x–xiii (hist. and syst.); Guldberg, Bull. Acad. roy. de Belgique (3), VII, 1884, 374–402 (chiefly historical); Nature, XXX, 1884, 148, 149.— Southwell, Proc. Nat. Hist. Soc. Glasgow, V (1880–1883), 1884, 66–69; Trans. Norfolk and Norwich Nat. Soc., III (1879–1884), 1884, 228–230 (supposed occurrence on coast of Scotland).— Newton, Quart. Journ. Geol. Soc. London, XLII, 1866, 316–324, pl. xi (fossil in Norfolk "forrest bed."— Graells, Mem. R. Acad. Cienc. Madrid, XIII, pt. 3, 1889, 86–88 (passim, pp. 1–110), pll. i–ix.— Jouan, Bull. Soc. Linn. Normandie (4), IV, 1890, 141–144 (recent captures in European waters).

Eubalæna biscayensis Flower, P. Z. S., 1864, 391.— Guldberg, Christiania Vidensk.-Selsk. Forhandl., 1891, 1–14; Zool. Jahrb., Abth. f. Syst., VII, 1893, 1–20, pll. i, ii (extern. and osteol. characters, etc., based on Iceland specimens).

Balæna (Hunterius) biscayensis Gray, Ann. and Mag. Nat. Hist. (4), I, April, 1866, 244.

Balæna cisarctica Cope, Proc. Acad. Nat. Sci. Phila., 1865, 168 (prelim. description), 273; Contr. Hist. Cetacea, 1866, 2 (same); in Allen, Bull. Mus. Comp. Zoöl., I, No. 8, 1869, 202 (covers notes by N. E. Atwood on its occurrence in Mass.); Proc. Acad. Nat. Sci. Phila., 1868, 194; *ibid.*, 1874, 89 (Raritan Bay, N. J.).— Gray, Ann. and Mag. Nat. Hist. (4), I, April, 1868, 244 (referred to his genus *Eubalæna*); *ibid.* (4), VII, Sept. 1870, 200.— Van Beneden, Ostéog. des Cétacés, livr. 4, 1868, pl. vii (tympanic bone of type described and figured); Bull. Acad. roy. de Belgique (2), XXVI, 1868, 15 (referred to *B. biscayensis*).— Fischer, Compt. rend. Acad. Sci. Paris, LXXII, 1871, 298–300; Ann. des Sci. Nat. (5), XV, 1872, art. 3, 1–20 (history and specific relations); Actes Soc. Linn.

de Bordeaux, XXXV, 1881, 10–55 (history, migrations, relationship).— Gasco, Compt. rend. Acad. Sci. Paris, LXXXVII, 1878, 412 (referred to *B. biscayensis*); Ann. and Mag. Nat. Hist. (5), II, Dec. 1878, 497; Ann. Mus. civ. Genova, XIV, 1879, 582.— Holder, Bull. Amer. Mus. Nat. Hist., I, No. 8, May, 1883, 99–139, pll. x–xiii (extern. and osteol. characters, histor. observations, etc.; first figures of American specimens).

Eubalæna cisarctica Gray, Ann. and Mag. Nat. Hist. (4), VI, 1870, 391.

Balæna britannica Gray, Ann. and Mag. Nat. Hist. (4), VI, Sept., 1870, 200 (fossil cervical vertebræ from Lyme Regis, Engl.).

Balæna tarentino Capellini, Mem. R. Accad. Sci. Bologna (3), VIII, 1877, 3–32, pll. i–iii (first description of Taranto specimen).— Doran, Ann. and Mag. Nat. Hist. (4), XX, 1877, 328 (ex Capellini).— Gasco, Atti R. Accad. Sci. Napoli, VII, No. 16, 1878, 1–47 (Taranto specimen, redescribed and referred to *B. biscayensis*, as done by all subsequent writers).

IV.— Geographical Distribution, Migrations, and Commercial Extinction.

It being conceded by leading cetologists that the Right Whale of the western North Atlantic is not specifically separable by any external or osteological characters from the Right Whale of the eastern North Atlantic, the limits of its range may be given in general terms as extending (formerly at least) over practically the whole North Atlantic,— from the coast of Florida and the Bermudas on the western side to the entrance to Davis Strait, the southern and southwestern coast of Greenland, and the waters about Iceland; and on the eastern side from the coast of Spain and (casually at least) the Mediterranean Sea northward to the seas between Norway and Spitzbergen; in other words, approximately that part of the North Atlantic between the January isotherms of 10° and 50° Fahrenheit, it occupying the northern part of this area in summer, and the southern part in winter. Its summer range thus slightly overlaps the winter range of the Greenland Right Whale, which is also migratory, being driven from its summer resort in the Polar seas by the winter ice; but it is not probable that both ever occupy the same area at the same time.[1]

The early annals of the Whale Fishery show that this whale was hunted in winter in the Bay of Biscay, and in summer was killed in large numbers in the waters between Spitzbergen and the North Cape. Also that at a later period the Basque, Norwegian, Dutch, and other whalers hunted it in summer in the seas about Iceland, and off the southeastern coast of Greenland, in the Straits of Belle Isle, and in the Gulf of St. Lawrence; and that in winter they were taken in Massachusetts Bay, off the coast of Long Island, in Delaware Bay, and along the coast of North Carolina. There is, however, scant evidence that they were ever numerous off Florida or around the Bermudas.

---

[1] Mr. A. Howard Clark says: "Resolution Island, at the entrance to Cumberland Inlet, is a good ground for both bowhead and right whales during April and May," but on what authority is not stated (*cf.* 'History and Present Condition of the Fishery,' in Fisheries and Fishery Industries of the United States, Section V, Vol. II, 1877, p. 18).

It is this species which formed the chief basis of the Basque Whale fishery "from time immemorial,"[1] and of that of all the seafaring nations of the thirteenth to the seventeenth centuries. The pursuit was so persistent that it became exterminated on the Atlantic coast of Europe by the end of this period, and a like fate later overtook it on the western side of the Atlantic.

As early as the middle of the sixteenth century the Basque whalers were engaged in its capture in the Gulf of St. Lawrence, where, and in the neighboring waters, they maintained an extensive whale-fishery during the following century, when this region became common ground for the whaling fleets of various nationalities; and it had here also become almost exterminated when the Bowhead or Greenland Right Whale became in turn the principal basis of this long continued industry.

The first settlers in New England and the Middle States found this species abundant on their arrival to these shores, and were not slow to avail themselves of so valuable an asset. During the middle of the seventeenth century whaling was established at Cape Cod, at Martha's Vineyard, at Nantucket, on Long Island, and in Delaware Bay, the whales being pursued at first in boats from the shore, and later in small vessels in the open sea. By the middle of the eighteenth century it had become so reduced in numbers that its pursuit was no longer profitable, and the whalers from these ports repaired to distant seas, and other species became their prey. A small remnant, however, remained, and a few are still captured nearly every year at different points along the eastern coast of North America, as in the entrance to Davis Strait, and from Cape Cod southward to the Carolinas,[2] and at much rarer intervals near Iceland and in European waters.

---

[1] *Cf.* Clements R. Markham 'On the Whale Fishery of the Basque Provinces of Spain.' Proc. Zool. Soc. London, 1881, pp. 969–976; Nature, XXV, 1882, pp. 365–368, Feb. 16, 1882. See previous reference to Markham under 'General History' (*antea*, p. 280).

[2] A. Howard Clark, writing twenty years ago, stated that this species was "taken during the summer months off the southern end of Greenland and to a limited extent in the lower part of Davis Strait, near Resolution Island. Along the eastern coast of the United States they are occasionally captured by shore whalemen, especially at the whaling stations of North Carolina. During the winter months, whalers find them on the Hatteras Ground, in the Gulf of Mexico, and the Caribbean Sea. At no particular place in the North Atlantic are they now abundant, though they were formerly taken in great numbers close to the New England shore, and eastward of the Newfoundland fishing-banks" (Fisheries and Fishing Industries of the United States, Sect. V. Vol. II, 1887, pp. 15–16).

No authority is given for the statement that "whalers find them . . . .in the Gulf of Mexico, and the Caribbean Sea," and in the face of explicit statements that it is not found there, its occurrence in these waters seems highly doubtful. Later in the same paper Mr. Clark himself quotes from an article in the 'London Field' (*l. c.*, p. 214) a passage from Alleyne S. Archer, based on fourteen years' experience in the whale fishery at Barbadoes, stating that "Right whales and sperm whales are never seen in these waters [Caribbean Sea], but the latter are often taken amongst the Leeward Islands."

According to Markham[1] and other authorities, the Basque shore whale-fishery, as already stated, was a well-established industry as early as the twelfth century, and probably by the tenth, and was pursued so persistently that by the middle of the seventeenth century the whales had become so scarce off the coast of Spain and France that these pioneers in the whaling industry had long before this date begun to make long voyages in its pursuit, transferring their activities to the seas about Iceland and Newfoundland, to which they began to make voyages in the last half of the sixteenth century. It was also hunted between Norway and Spitzbergen so incessantly by the Norwegian, Dutch and German whalers during the sixteenth and seventeenth centuries that it had also here become scarce, and its pursuit practically abandoned for that of the Greenland Whale. By the middle of the eighteenth century it is a matter of record[2] that the New England whalemen repaired to the Newfoundland whaling grounds in pursuit of whales, owing to the great decrease in numbers of the present species along the Atlantic coast of the United States.

The pursuit of this species along the coast of New England and the Middle States began in a small way with the earliest settlement of the country by Europeans, at first in boats along the shore, and later in small vessels in the open sea, as is shown by the following excerps from various authorities. A few whales, in addition to stranded or drift whales, were taken in Massachusetts Bay as early as 1631, and whaling began to be prosecuted at Martha's Vineyard in 1652, and at Nantucket in 1672; it was first established at Southampton, on Long Island, in 1644, and at Easthampton in 1651, and had become quite active by 1688, and was subjected to legal regulation in 1672. The whaling season began early in November and ended usually by the middle or toward the last of March, although whales were sometimes seen as early as the middle of October and as late as April. From 1720 on, whaling was carried on in small vessels in the open sea, as well as in boats from the shore. By 1750, the whales had become so few that pursuit of them as an industry was practically abandoned, but they have been taken at various points along the coast from Massachusetts Bay to North Carolina, at intervals, from this date till the present time, by boats from the shore, particularly from the southern side of Long Island and on the coast of North Carolina, one or two, and sometimes more, being taken in a single season, but usually only at intervals of several years.

Respecting its former abundance along the New England coast, the following passages are of interest.

---

[1] A. Howard Clark, *l. c.*, pp. 969–976.

[2] *Cf.*, especially, Alexander Starbuck's 'History of the American Whale Fishery from its earliest inception to the year 1876.' Report of the U. S. Commissioner of Fish and Fisheries, Part IV, 1875–1876 (1878), pp.1–768, pl. i–vi.

In Mourt's 'A brief Relation of the Discovery and Plantation of New England,' published originally in 1622,[1] we find enumerated among the advantages offered by Plymouth as a place of settlement the following: "Thirdly, Cape Cod was like to be a place of good fishing; for we saw daily great whales of the best kind for oil and bone, come close aboard our ship, and in fair weather swim and play about us; there was once one, when the sun shone warm, came and lay above water, as if she had been dead, for a good while together, within half a musket-shot of the ship. . . . " This was, of course, early in the month of December, 1620, and the species referred to could not have been other than that here under consideration.

Zaccheus Macy, in his account of Nantucket,[2] dated "Nantucket, 15th of 5th month, 1792," alludes briefly to the whale-fishery, in which he says: "The whale fishery began at Nantucket in the year 1690. One Ichabod Paddock came from Cape Cod to instruct the people in the art of killing whales, in boats from the shore. This business flourished till about the year 1760, when the whales appeared generally to have deserted the coast. . . . In the year 1718, the inhabitants began to pursue whales on the ocean, in small sloops and schooners, from thirty to forty-five tons. The blubber was brought home in large square pieces, and *tried* or boiled in try-houses. In a few years, vessels from sixty to eighty tons were employed and the oil boiled out in try works at sea. When the late war began with Great Britain we had a fleet of about one hundred and forty sail, consisting of large sloops, schooners, and brigs. But when the war ended, we were reduced to about thirty old hulks. Our voyages are now long and distant. . . ."(*l. c.*, p. 157).

William Douglass, in his 'Summary, Historical and Political,. . . . of the British Settlements in North America' (London, 1760), in speaking of the New England Whale-fishery (Vol. I, pp. 296–298) says: "Whales, that is the true or bone whales go southward (they are passengers according to the seasons) towards winter, and return northward in the spring. Formerly, in New-England Cape-cod embayed them, but being much disturbed (they seem to have some degree of reason) they keep a good offing. . . .

"New-England whaling at present is by whaling sloops or schooners with two whale-boats and thirteen men; each boat has an harpooner, a steersman, and four rowers; the whale-boats do not use thaughts, but nooses for their oars, upon account of expedition; because only by letting go their oars, without loosing of them, they keep expeditiously long side of the whale. The best place of striking a whale is in her belly, about one-third from her gills; the fast is a rope of about twenty-five fathom; then a drudge or stop-water, a plank of about two feet square, with a stick through its center; to the further end of this stick, is fastened a tow-rope, called the drudge rope, of about fifteen fathom; they lance, after having fastened her by the harpoon, till dead.

---

[1] Here quoted from Massachusetts Hist. Coll., 2d ser., Vol. IX, p. 36.

[2] A short Journal of the first settlement of the island of Nantucket, with some of the most remarkable things that have happened since, to the present time. Coll. Massachusetts Hist. Soc., III, 1794, pp. 155–161.

"The New England whalers reckon so many ct. wt. bone, as bone is feet long: for instance, sevenfoot bone gives 700 wt. bone: New England bone scarce ever exceeds nine feet; and 100 barrels of oil is supposed to yield 1000 wt. of bone: whales killed in deep water, if they sink, never rise again...."

Hector St. John, in his account of the island of Nantucket,[1] gives incidentally a brief notice of the origin of whaling from that island. He says: "The first proprietors of this island, or rather of this town, began their career of industry with a single whale-boat, with which they went to fish for cod; the small distance from their shores at which they caught it enabled them soon to increase their business, and those early successes, first led them to conceive that they might likewise catch the whales, which hitherto sported undisturbed on their banks. After many trials and several miscarriages, they succeeded; thus they proceeded, step by step; the profits of one successful enterprise helped them to purchase and prepare better materials for a more extensive one: as they were attended with little costs, their profits grew greater. The south sides of the island from east to west, were divided into four equal parts, and each part assigned to a company of six, which though thus separated, still carried on their business in common. In the middle of the distances they erected a mast, provided with a sufficient number of rounds, and near it they built a temporary hut, where five of the associates lived, whilst the sixth from his high station carefully looked toward the sea, in order to observe the spouting of the whales. It may appear strange to you, that so slender a vessel as an *American whale-boat*, containing six diminutive beings, should dare to pursue and attack, in its native element, the largest and strongest fish that nature hath created. Yet by the exertion of an admirable dexterity, improved by a long practice, in which these people are become superior to any other whalemen; by knowing the temper of the whale after her first movement, and by many other useful observations; they seldom failed to harpoon it, and bring the huge leviathan on the shores. Thus they went on until the profits they made, enabled them to purchase larger vessels, and to pursue them farther, when the whales quitted their coasts;...."

Not only, in early times, were many whales taken along the shores of Nantucket and Martha's Vineyard, but also along the southern shore of

---

[1] Letters from An American Farmer, ed. of 1782, pp. 153–154.

Long Island, particularly at the eastern end of the island, being at first pursued in open boats from the shore, as along the coast of New England. Southold and East Hampton were for a time especially noted for this enterprise. Hubbard, in his 'History of New England,' speaks of Southold as the place "where the inhabitants of late [about 1680] have fallen upon the killing of whales, that frequent the south side of the island in the latter part of the winter, wherein they have a notable kind of dexterity; and the trade that ariseth therefrom hath been very beneficial to all that end of the island." Again he says: "Upon the south side of Long Island, in the winter, lie store of whales and grampuses, which the inhabitants begin with small boats to make a trade of catching, to their no small benefit." [1]

Somewhat earlier than this Samuel Mavericke, in a letter to Col. Richard Niccolls, dated "New Yorke, July 5th 1669" wrote in relation to Whales, as follows: "On y^e^ East end of Long Island there were 12 or 13 whales taken before y^e^ end of March, and what since wee heare not: here are dayly some seen in the very harbour, sometimes within Nutt Island. Out of the Pinnace the other week they struck two, but lost both, the iron broke in one, the other broke the warpe. The Governour hath encouraged some to follow this designe. Two shallops made for itt, but as yett wee doe not heare of any they have gotten." [2]

Further respecting the capture of whales on Long Island we have the following from Lord Cornbury's report to the Board of Trade, dated "New York, July the 1st 1708": "We have all sorts of Trades here, and some of every sort that work well;. . . .The quantity of Train Oyl made in Long Island is uncertain, some years they have much more fish than others, for example last year they made four thousand Barrils of Oyl, and this last Season they have not made above Six hundred; About the middle of October they begin to look out for fish, the Season lasts all November, December, January, February and part of March; a Yearling will make about forty Barrils of Oyl, a Stunt or whale two years old will make sometimes fifty, sometimes Sixty Barrils of Oyl, and the largest whale that I have heard of in these Parts, Yielded one hundred and ten barrels of Oyl, and twelve hundred Weight of Bone,. . . . " [3]

During subsequent years, down to as late as 1718, there were frequent disputes between the captors of whales and the rights of the crown to a share of the spoils, but there is no definite information as to the number of whales taken, at which time Robert Hunter, in his report of date July 7 of that year to the "Lords of Trade," stated, the "licences for Whale Fishing" "has not any time amounted to 20 Sterling p^{r} annum, that fish having in a manner left this coast."[1] Later, however, acts were passed to encourage whale-fishing.[2]

---

[1] Hubbard's History of New England, in Massachusetts Hist. Coll., 2d ser., Vol. VI, 1815, pp. 668, 669, 673.

[2] Doc. relative to Col. Hist. New York, Vol., III, p. 183.

[3] *Ibid.*, Vol. V, pp. 59, 60.

Thompson, in his 'History of Long Island' (edition of 1839, p. 221) says, in writing of Southampton: "The whaling business upon this part of the island has existed, in some form or other, for a great length of time, and may be said to be almost coeval with the settlement of the country by the white people. Both individuals and companies at an early period were engaged in the pursuit of whales along the south shore, in boats built expressly for the purpose, and kept ready at convenient stations upon the beach. In the year 1760, three sloops, owned by Joseph Conckling, John Foster, and a few others, called the *Goodluck, Dolphin,* and *Success*, cruised for whales in latitude 36° north. Whales at that period were more abundant along-shore than at present, although some are yet taken by boats at East and Southampton almost every year. The whales when secured were drawn upon the shore, cut in pieces, and conveyed a distance to be boiled out. This process was so offensive, that the town meeting of Easthampton, in 1690, prohibited the practice within a certain distance of any habitation." In the second edition of the work, published in 1843, the author adds: "In the Long Island Herald, published here, of the date of April 12, 1792, it is stated, that *twelve stout whales* were killed during the spring off the southside of the island."[3]

The Province of West New Jersey passed 'An Act relating to Fishing,' in October, 1693. The act relates wholly to the capture of whales in Delaware Bay, and implies that the whale fishing of Delaware Bay was of considerable importance, the act beginning as follows: "Whereas the Whalery in *Delaware* Bay has been in so great a Measure invaded by Strangers and Foreigners, that the greatest Part of Oyl and Bone, recovered and got by that imploy hath been Exported out of the Province, to the great detriment thereof; to obviate which mischief, BE IT ENACTED. . . .that all Persons not residing within the Precincts of this Province, or the Province of *Pennsylvania,* who shall kill or bring on shore any Whale, or Whales within *Delaware* Bay, or elsewhere within the Boundaries of this Government, shall pay one full and entire Tenth of all the Oyl and Bone made out of the said Whale, or Whales, unto the present Governor of this Province for the Time being."[4]

Ricketson says, in his 'History of New Bedford' (p. 56), published in 1858: "The attention of the early settlers of New England was early called to the whale-fishery. . . .As early as 1690 they had reached the banks of New Foundland in their pursuit of whales. But the voyages of the early whalemen of Nantucket and New Bedford were upon the coast, and for several years did not reach beyond the capes of Virginia and Cape Hatteras. The 'Right Whale,' *balæna mysticetus,* was the only species known to the first adventurers."

---

[1] Doc. relative to Col. Hist. New York, Vol. V, p. 510.

[2] *Ibid.*, Vol. V, pp. 583, 782, Vol. VI, p. 160.

[3] Hist. of Long Island, 2d ed., Vol. I, p. 349.

[4] Leaming and Spicer's Grants Concessions, and Original Constitution of the Province of New Jersey, etc. (no date), pp. 519, 520.

Says Pitkin:[1] "The whale fishery first attracted the attention of the Americans in 1690, and originated in boats from the shore. In 1715, six sloops, of thirty-eight tons burden each, were employed in this fishery, from that [Nantucket] island. For many years their adventures were confined to the American coast, but as whales grew scarce here, they were extended to the Western Islands, and to the Brazils, and at length to the North and South Seas[2]. . . .In 1731, the Americans had about thirteen hundred tons of shipping employed in this fishery along their coast. About the year 1750, the whale left the American coast."

Crapo, in his 'Historical Address,' delivered on the occasion of the 'Centennial in New Bedford,' July 4, 1876, has given (pp. 64, 65) extracts from the records of the town of New Bedford,[3] under dates November 11, 1652, April 13, 1653, April 15, 1690, February 19, 1692, and "1792–3," which show that whales at that time were occasionally stranded or captured along the shores of Martha's Vineyard. Under the last-mentioned date three whales killed in February 1793, are referred to as "great whales, betwixt six and seven and eight foot bone."

An extract from the 'Nantucket Inquirer' (newspaper) states: "In the year 1680 [1690?] a Mr. Paddock from Cape Cod came to Nantucket to instruct the English how to whale in boats from the shore, which business continued good till 1760, when it became poor by the scarcity of whales. In the spring of 1726, there were *eighty-six* whales caught here. One Mr. Loper previous to this was engaged in the business, but not to any amount worthy of record." (Crapo, *l. c.*, p. 67.)

These extracts could be greatly extended, but those already given are sufficient to show how important a rôle this species of whale played in the early maritime history of the New England and Middle States; also its former abundance, and how a century of pursuit for its commercial products reduced it to commercial extinction.[4]

---

[1] Statis. View Comm. United States, etc., 1816, pp. 42, 43.

[2] "See Collections of the Massachusetts Historical Society," [Vol. not stated].

[3] Accredited to Richard A. Pease's valuable 'Historical Sketches of Martha's Vineyard' (probably in the 'Vineyard Gazette,' which I have been unable to see).

[4] Since the above extracts were compiled (in 1881) from the original sources, some of them have appeared in later works on the American Whale-fishery, where many more of similar import may be found. See especially, Alexander Starbuck's 'History of the American Whale Fishery from its earliest Inception to the year 1876' (Report of the Commissioner of Fish and Fisheries for 1875–1876, Part IV, 1878, pp. 1–763); A. Howard Clark's 'History and present conditions of the [Whale] Fishery (Fisheries and Fishery Industries of the United States, Sect. V, Vol. II, 1887, pp. 1–218); J. B. Holder's 'The Atlantic Right Whale' (Bull. Amer. Mus. Nat. Hist., I. 1883, pp. 99–137); Frederick W. True's 'The Whalebone Whales of the North Atlantic' (Smiths. Contr. to Knowl., Vol. XXXIII, 1904).

V. External and Osteological Characters.

Thanks to the valuable contributions of Cope (1865), Holder (1883), True (1904), and Andrews (1908), the external and osteological characters of the Right Whale of the Atlantic coast of North America, are now well known — better even than those of its representative on the Atlantic coast of Europe, as made known by Capellini, Gasco, and Graells, on the basis of three immature specimens captured, respectively, at San Sebastian and Guittare, Spain, and in the Bay of Taranto, Italy. Guldberg has also described both young and adult specimens from Iceland.

Ten skeletons of American specimens are preserved in American Museums (and none elsewhere[1]), of six of which Mr. True was able to give notes and measurements in 1904. There is still another in the Museum of Comparative Zoölogy at Harvard University, here for the first time described, and the two recently acquired by this Museum. External measurements of three others, of which no part appears to have been preserved, are also given by Mr. True. The present location, place and date of capture, of these skeletons is as follows, in geographic sequence from north to south.

Skeletons in Museums.

Provincetown, Mass.	April, 1864	Mus. Comp. Zoölogy, Cambridge, Mass.
Long Island, N. Y.	——	Field Mus., Chicago, Ill.
Amagansett, L. I., N. Y.	1888	U. S. Nat. Mus., Washington, D. C.
Long Island, N. Y.	1875 ?	Amer. Mus. Nat. Hist., New York.
Amagansett, L. I., N. Y.	Feb. 22, 1907	" " " " " "
" " "	" " "	" " " " " "
Delaware Bay.	1862	Mus. Acad. Nat. Sci. Philadelphia, Pa.
Beaufort, N. C.	1874	State Mus., Raleigh, N. C.
Cape Lookout, N. C.	Feb. 15, 1898	Mus. University of Iowa.[2]
Charleston, S. C.	Jan. 7, 1880	Charleston College Mus., Charleston, S. C.

The two Long Island specimens recently acquired by this Museum have already been sufficiently described (*antea*, pp. 171–182, figs. 1–6), so that it remains merely to add some account of the Provincetown specimen, with illustrations[3] of some of the more important parts of the skeleton, and to briefly summarize the external characters as made known by other writers.

---

[1] Since this was written the younger of the two Long Island specimens, secured by this Museum in 1907, has been sent to the University Museum, Cambridge, England, in exchange for other material.

[2] Not "Wisc. Acad. Sci." (which has no Museum), as given by True, 'Whalebone Whales,' etc., p. 246.

[3] These illustrations are reproduced from unpublished lithographic plates made by T. Sinclair & Son, Philadelphia, in 1881, for a monograph of the North American Cetacea then in course of preparation by the writer for the United States Geological Survey of the Territories, under the late Dr. F. V. Hayden, Director, as already explained (*antea*, p. 280). They are published here with the kind approval of the Hon. James R. Garfield, Secretary of the Department of the Interior. The drawings were made under my supervision by the well-known

Size.— The largest American specimen thus far recorded is the adult female taken at Amagansett, Long Island, February 22, 1907, which, according to the measurements taken by the whalemen and given to Mr. Andrews, was 56 feet 7 inches from the tip of the snout to the end of the flukes, or 54 feet from the tip of the snout to the notch of the flukes, as measured by Mr. Andrews himself. A much younger female, taken at the same time and place, was about one fourth less in linear measurements, with a disproportionately much shorter head. The next largest American specimens are two taken on the coast of North Carolina, respectively an adult female and an adult male, which measured (total length), according to Brimley, respectively 53 feet and 50 feet.[1] Nearly all of the other American specimens of which measurements have been recorded were obviously immature. According to Guldberg, the largest of six Iceland specimens had a total length of 51 feet 8 inches; the next largest, 47 feet 7 inches. As already said, all of the extant European specimens are young, and hence not comparable with adults. The largest European specimen of which measurements have been recorded is the Ré Island example, captured in 1680, and reported variously as adult and young, with a total length of 50 feet 7 inches. The length of adults of this species may be regarded, therefore, as ranging from about 48 to 54 feet. Measurements based on the skeleton seem to average, in a full-grown specimen, about 5 feet less than the total length in the flesh. Something depends upon how the external measurements are taken, as differences of method may considerably vary the results, and especially the ratio of the length of the head to the total length. It is evident, however, that the length of the head is disproportionately less in young animals than in adults.

Color.— According to the published descriptions of this whale, the color is usually a uniform "ivory black," "deep black," or "blue black," but, as in other whales that are ordinarily wholly black, they are subject to white mottling, especially on the pectoral limbs, the flukes, and lower surface of the body, which, in rare instances, may be largely white. Mr. H. H. Brimley in a paper on 'Whale Fishing in North Carolina'[2] thus describes the coloration of specimens taken on the coast of North Carolina: "Its color is a dense shining ivory black above, while below the color and appearance is that of the purest polished ivory white, the white often extend-

---

natural history draftsman James Henry Blake, of Cambridge, Mass., and are not only artistic but possess the utmost accuracy. For the use of the material I am indebted to Mr. Alexander Agassiz, for so many years Director of the Museum of Comparative Zoölogy. The specimen from which they were taken was captured at Provincetown, Mass., in April, 1864, by Captain N. E. Atwood and Capt. R. Soper, and secured by Professor Louis Agassiz for the Museum through the Gray Fund.

[1] *Cf.* True, *l. c.*, p. 246.

[2] Bulletin of the North Carolina Department of Agriculture, Vol. XIV, No. 7, April, 1894, pp. 4–8, with illustrations.

ing some distance up the sides. Sometimes it is pied below and the amount of white is very variable, and sometimes, again, pure black specimens are killed, showing no white at all. The line between the color is always sharply defined, although the dividing line is very irregular. There is no shading through the skin to the pink blubber, whether the color be black or white. The white-bellied whales yield the most oil and they usually have a patch of white on the tip of each fluke, so that if only the flukes are seen as the whale goes down the fishermen can often tell whether or not it is a white-belly that they are pursuing" (*l. c.*, p. 7). Mr. Andrews (*antea*, pp. 172, 174) refers to white spots on one of the Amagansett whales observed by him, and quotes Captain J. B. Edwards, an old whaleman of Amagansett, as stating: "I have seen several Right Whales with white markings or spots on the sides, and some with the breast and throat nearly all white." Guldberg refers also to the occurrence of white spots on the Iceland specimens captured by Captain Berg. Hence it is evident that specimens of this species showing more or less white are not peculiar to any particular locality; that the amount of white present may vary in amount from a few small spots to large areas, occupying considerable portions of the ventral surface; and that, when present, they are not superficial but involve the whole thickness of the skin down to the pink blubber.

PROVINCETOWN SPECIMEN.

This, when studied, was a partly disarticulated skeleton, sex not recorded, of a specimen secured at Provincetown, Mass., for the Museum of Comparative Zoölogy in April, 1864.[1] According to Captain Atwood,[2] one of its captors, it yielded 80 barrels of oil, and the whalebone was sold for $1,000. The length in the flesh is said to have been 48 feet.[3] The skull is shown in profile (Plate XIX), from above (Plate XX), and from behind (Plate XXI, fig. A). The principal dimensions are as follows:

Measurements of the Skull.

	mm.
Total length, axial, from occip. condyles to tip of intermax.	3650
" " following curvature	4500

---

[1] Van Beneden, in referring to this specimen (Bull. Acad. Roy. de Belgique (2), XXX, 1870, p. 385) erroneously conjectured it was captured in summer.

[2] *Cf.* Allen, Bull. Mus. Com. Zoöl. I, No. 8, 1869, p. 202.

[3] On the authority of Prof. W. H. Niles of the Massachusetts Institute of Technology, who was in charge of the preparation of the skeleton, he then being a student at the Museum of Comparative Zoölogy. According to information recently received from my friend Mr. James Henry Blake, this whale was captured in Massachusetts Bay, near the Plymouth shore, and towed into Provincetown harbor. The skeleton remained many years at the Museum before it was mounted (in 1888) and placed on exhibition. The original whalebone was sold, as stated above, for $1000 at the time the specimen was captured, and that now attached to the skull is a clever restoration, hardly distinguishable on casual inspection from the original. Mr. Blake gives the length of the animal in the flesh as 47 feet, and the yield of oil as 83 barrels and 14 gallons. Some of the whalebone was seven feet in length.

	mm.
Occipito-frontal suture to post. border of occip. condyle	740
Fronto-nasal suture to " " " "	880
Anterior border of nasals to post. border of occip. condyle	1160
Length of nasals, along outer border	350
" " " " inner "	250
Breadth of nasals anteriorly	330
" " " posteriorly	330
Length of maxillary, axial	2780
" " " following curve of sup. external border	3150
Length of intermaxillary, axial	2810
" " " along dorsal convexity	3260
Breadth of skull at orbital processes of frontal	2500
" " " at zygomatic processes	2325
" " " at mastoid processes	1590
Greatest breadth of occipital bone	1090
Transverse breadth of occipital condyles	240
Antero-posterior breadth " "	285
Transverse diameter of neural canal	145
Antero-posterior diameter of neural canal	136
Length of mandible, axial	3270
" " " along external curvature	4000
Greatest depth	430
Transverse diameter of condyle	360
Vertical " " "	370

The principal dimensions of this skull, in comparison with those of seven other adult skulls of this species — three from the coast of the United States and four from Iceland — embracing all known that are comparable with it as to age, are as follows:

Comparative Measurements of Eight adult Skulls of Eubalæna glacialis (Bonn.).

	America.				Iceland.				
Total length (straight)	4140[1]	3861[2]	3810[3]	3650[4]	3920[5]	3910[6]	3830[7]	3380[8]	mm.
Orbital breadth	2591	2553[9]	2362[9]	2500	2550	2460	2500	2150	"
Lower jaw (straight)	3912	3478[9]	3334[9]	3270	3820	3900	3820	3190	"
" " (along curv.)	4318	3861[9]	4077[9]	4000	4033	——	4030	3480	"

---

[1] Amagansett, Long Island, N. Y., Feb. 22, 1907; in American Museum of Natural History, New York City. Female. Measurements from R. C. Andrews, Bull. Amer. Mus. Nat. Hist., XXIV, 1908, p. 178.

[2] Cape Lookout, N. C., March 20, 1894; in State Museum, Raleigh, N. C. Male. Measurements from F. W. True, Whalebone Whales of the Western North Atlantic, 1904, p. 253.

[3] Long Island, New York; in Field Museum, Chicago, Ill. Measurements from True, *l. c.*

[4] Provincetown, Mass., April, 1864; in Museum Comparative Zoölogy, Cambridge, Mass. Measurements original.

[5] Iceland, 1891; in University Museum, Christiania. Male. Measurements from Guldberg, Zool. Jahrb., Abth. f. Syst., VII, 1894, 14.

[6] Iceland, 1891; in University Museum, Christiania. Male. Measurements from Guldberg, *l. c.*, p. 10.

[7] Iceland, 1890; in University Museum, Christiania. Measurements from Guldberg, *l. c.*, p. 10.

[8] Iceland, 1891; in Bergen Museum. Measurements from Guldberg, *l. c.*, p. 13.

[9] Calculated on the basis of Mr. True's table of precentages.

Although practically adult, it is slightly exceeded in size by all of the others except one of the Iceland examples.

Vertebral Column.— The vertebral formula in this species seems subject to slight variation, as is the rule with most animals, through variation in the number of lumbars or caudals, which Mr. Andrews has found to vary in two specimens taken at the same time and place on Long Island. The total number seems to range from 55 to 57, with the average at 56, which is the number in the Provincetown specimen, namely: C. 7, D. 14, L. 11, Ca. 24 = 56.

Cervical Vertebræ.— The cervical vertebræ (Plate XXII, Figs. D–H) differ in several notable particulars from any of those thus far figured as belonging to the genus *Eubalæna,* and are especially interesting as presenting a wonderful degree of bilateral asymmetry. Viewed in profile the spinous processes are united above from the 1st to the 5th inclusive, the 6th and 7th alone being free, both as regards each other and those preceding them. Of the transverse processes, those of the first cervical only are wholly free on both sides, those of the others being united at their extremities into groups which may be indicated as follows: left side, 1, 2, 3–4, 5–6–7; right side, 1, 2–3, 4–5–6–7. In the first cervical the transverse processes have no inferior lamellæ, but they are developed from the 2d, 3d, and 4th on the left side, and from the 2d and 3d on the right. Those of the 2d and 3d on each side are united basally; that of the 3d is much smaller and is free throughout its length.

In viewing the cervical vertebræ from below, the 1st and 7th are seen to be separated from the others by well-marked sutures, but there is no trace of sutures, at least medially, between the other cervicals.

The transverse processes of the atlas are rather short but very broad and thick; that of the left side much heavier than that of the right, the whole left half of the atlas being in fact very much more developed than the right, as is distinctly seen in Plate XXII, Fig. E. The transverse processes of the axis are rather longer than in the atlas, but many times more slender; those of the succeeding vertebræ decrease in length and size to the 6th; the 7th is rather heavier than the 6th.

A striking feature in the present example is the slight degree of ankylosis between the atlas and the axis, which have actually coalesced at only three points, namely: by a small portion of the centra at the base of the transverse processes, and by the union of the neural spines.

The cervical vertebræ of the type of *B. cisarctica* Cope are shown on the same plate (Plate XXII, Figs. A–C) for comparison. They represent a much younger and smaller specimen, with many differences in the details of ankylosis.

Measurements of the Cervical Vertebræ.[1]

	mm.
Transverse breadth of atlas	655
Vertical breadth of atlas	455
Transverse breadth of articular surface	370
Transverse breadth of articular surface of right half	170
Vertical breadth of articular surface of left half	270
Depth of articular concavity	90
Transverse diameter of 2d cervical	645
“ “ “ 7th “	560
“ “ “ centrum of 7th cervical	270
Vertical diameter of 7th cervical	230
Length of centra (2d–7th) superiorly	150
“ “ “ (1st–7th) superiorly	200
“ “ “ (1st–7th) inferiorly	240
Length of crest formed by neural spines	360
Length of neural spine of 1st cervical	110
Length of neural spine of 7th cervical	90
Transverse breadth of neural canal anteriorly	155
“ “ “ “ “ posteriorly	193
Vertical diameter of neural canal anteriorly	140
“ “ “ “ “ posteriorly	150

Measurements of other Vertebræ.

	6th D. mm.	6th L. mm.	6th Ca. mm.
Vertical diameter of centrum, anteriorly	220	265	310
Greatest transv. diameter of centrum, ant.	250	300	320
Length of centrum, ventral border	100	155	170
Height of vertebra to top of spine	560	675	580
Greatest breadth of transv. processes	585	1120	600
Transv. diameter of neural canal	190	130	76
Vertical ‘ “ “ “	110	135	75

Measurements of First Pair of Ribs.

	Right mm.	Left mm.
Length in straight line	1235	1120
“ along convexity	1410	1260
Breadth at distal end	325	240

Scapula.— The scapula is symmetrically fan-shaped, the superior border regularly rounded. Viewed from above the superior or suprascapula border is slightly sinuous, being feebly sigmoidal. The cartilaginous portion is wanting. The glenoid border presents an oval outline, with the antero-posterior diameter one-fifth greater than the transverse. The acromion process is flat, rather narrow and long, slightly broadest at base, the average width being rather more than one-half the length. The coracoid is undeveloped. The point of greatest contraction of the blade is just below the acromion process; from this point it abruptly expands to form the broad, deeply hollowed glenoid fossa. The blade is slightly concavo-convex, the surface smooth. The following are the principal measurements: Greatest length, 1011 mm.; extreme breadth, 830 mm.; length of suprascapular border, following the curvature, 1270 mm.; circumference just below the acromion process, 710; transverse breadth of glenoid fossa, 240; antero-posterior breadth of same, 310; length of acromion process, 200; greatest breadth of same (at base), 130; thickness of suprascapula border, 60–75 mm. (Plate XXIV, Fig. A.)

---

[1] Without the epiphyses.

The scapula varies in size and somewhat in form in different individuals, and even in the same animal, as shown by the following table.

	mm.		mm.		
Height,	1020	breadth,	1250	Iceland (Guldberg).	
"	1080	"	1220	"	"
"	965	"	1200	right	Amaganset (Andrews)
"	953	"	1143	left	
"	830	"	1011	Provincetown (Allen).	

Pectoral Limb.— The bones of the right pectoral limb (Plate XXIV, Fig. B) were still (when studied) held in place by cartilage, except the 5th digit, the phalanges of which, however, were still ligamentously connected. Only the terminal phalanx of the 3d and 4th digits were wanting. The distal epiphysis of ulna and radius are ununited, while the proximal are firmly ankylosed, as are both epiphyses of the humerus. The *humerus* is a short, thick bone, deeply constricted around the middle, expanding distally for articulation with the bones of the forearm, and becoming greatly enlarged at the proximal end. The following are its principal measurements:

	mm.
Extreme length	520
Greatest transverse diameter proximally	375
" " " of head	325
" " " distally	300
Antero-posterior diameter of head	300
Least circumference of shaft at middle	600

The *radius* is broad and flat distally, the transverse breadth of the distal border equalling seven tenths of the total length of the shaft; proximally it is much less expanded and much thicker. The point of least breadth is at one fourth the whole length from the proximal end. The following are the principal measurements:

	mm.
Extreme length (near the anterior border)	555
Transverse diameter of proximal end	240
Antero-posterior diameter of proximal end	155
Transverse diameter of distal end	350
Antero-posterior diameter of distal end	165
Least transverse diameter of shaft	185

The *ulna,* like the radius, is fan-shaped in its distal two thirds, and greatly thickened proximally. The length of the distal border is rather more than one half of the total length of the bone. Its principal measurements are as follows:

	mm.
Extreme length	480
Transverse diameter of distal end	280
Least transverse diameter	110
Antero-posterior diameter of distal end	90

The *carpal bones* are wholly concealed in the hardened cartilage.

The *digits,* five in number, decrease in length in the following order: III, II, IV, V, I. Digit III, has 6 phalanges; digit II, 5; digit IV, 4; digit V, 3; digit I, 2.[1] (Plate XXIV, Fig. B.) In respect to the relative length of the digits, the number of phalanges in each, and the relative length of digit III, in comparison to the whole limb, the manus in the present species closely resembles that of *Balæna mysticetus.* The number of phalanges in the several digits appears to be variable, as is known to be the case in other cetaceans.

Measurements of Bones of the Manus.

	Digits.				
	I	II	III	IV	V
	mm.	mm.	mm.	mm.	mm.
Length of 1st phalanx	120	170	160	160	150
" " 2d "	?90	155	160	140	130
" " 3d "		125	160	108	95
" " 4th "		95	120	?60	
" " 5th "		55	85		
" " 6th "			?60		
Total length[2]	?255	730	?910	?520	430

The total length of the pectoral limb, measured from the most proximal point of the head of the humerus to the tip of the longest digit, falls, in the

---

[1] True (*l.c.*, p. 261) has given a different formula for this specimen, but on what authority is not stated. My examination, however, was made when all the parts were *in situ*, and were thus drawn (see Plate XXIV, Fig. B). Mr. True refers to the impracticability of attempting to give reliable formulæ from mounted specimens in American Museums, and it may be added in corroboration of this statement that the mounted specimen in this Museum, of which the digital formula is given by True, proves on examination to have nearly all of the metacarpals and phalanges restored in wood!

[2] Includes the dried cartilage between the nodes as well as that terminating the digit.

dried state, a little short of two meters (1970), of which the upper and fore-arm bones constitute one half; probably in life the carpus and manus would together equal the upper and fore-arm segments.

Sternum.— The sternum (Plate XXIII, Fig. A) is an irregularly oval buckler, convex externally, flat internally, and consequently much thicker in the middle than toward the edges. The upper border is greatly rounded, the lower more pointed. Its greatest diameter is 250 mm., its length 320 mm.

In form this sternum is quite different from any hitherto figured, but most nearly approaches that of the Chicago Field Museum specimen (True *l. c.*, pl. 46, fig. 3), and the Taranto, Italy, specimen (True, *l. c.*, text fig. 85, p. 258). It is very unlike the figure that purports to represent this specimen given by True (*l. c.*, pl. 46, fig. 4). The sternum of the first American Museum specimen figured by True (*l. c.*, text fig. 87, p. 258) is a restoration in wood, doubtless modeled after that of a fin-whale, supplied by the preparator. There is obviously, however, great individual variation in the form of the sternum in this species. The five known examples differ markedly from each other, but the tendency is toward a more or less heart-shaped form, as in the specimen figured by Andrews (*cf. antea*, p. 181), and in the Iceland specimen figured by Guldberg (*l. c.*, pl. ii, fig. 4).

Pelvic Bones.— Only one of these, the left, is preserved. It was heavily enveloped in dried cartilaginous tissue and is evidently complete. On carefully removing this tissue from the ossified portion, it was found to be a soft porous bone, 220 mm. in length and 70 mm. in greatest width. As shown in Plate XXIII, Fig. I, the lower border is strongly arched. The anterior two-thirds is greatly expanded, rising into a high, obtusely rounded convexity, having an inward curvature. The posterior third is cylindrical. The point of the greatest expansion is a little anterior to the middle of the bone. If there were originally connected with it vestiges of a pelvic limb, these parts must have been overlooked or lost. This seems, however, improbable, as the preparation of the skeleton was made under most intelligent supervision; the investing cartilage, which was in tact when these parts were studied, would also seemingly have shown trace of connection with appendages, if they had been as well developed as those shown in Guldberg's plate (*l. c.*, pl. ii, figs. 5–7), had any such existed. The pelvic element described by Guldberg has twice the linear dimensions and a much greater mass than in the Provincetown specimen, with an attached femur 125 mm. long, and having a thickness of 72 to 88 mm.

In the Amagansett whale, described by Mr. Andrews (*antea*, pp. 171–182), the pelvic bones are well developed, crescent-shaped, and abruptly expanded in front of the middle, thence tapering rapidly anteriorly, and extending posteriorly as a somewhat flattened, cylindrical bone, becoming thickened at the posterior extremity. The right pelvic bone, measured along the curvature of the dorsal margin, has a length of 450 mm.; the left one a length 435 mm. Each pelvic bone had attached to it a vestigial femur,— a flattened bone, 135 mm. long, 58 mm. wide, and 10 to 28 mm. thick, parallel-sided for about half the length, with one entire side straight, the other sloping at an obtuse angle. Unfortunately they were separated from the pelvic bones before their position and manner of attachment was noted. One of the pelvic bones with its vestigial femur is shown in the accompanying text figure.

The pelvic bone and femur in *Eubalæna glacialis* greatly resembles these bones in *Balæna mysticetus*, as described and figured by Struthers.[1] In each species there is evidently a wide range of individual variation in respect to the size and form of these bones, as shown in the eleven specimens of *B. mysticetus* described by Struthers, and by the several specimens of *E. glacialis* described and figured by Guldberg, and the two described in the present paper. These variations affect the curvature and thickness, as well as the general size, of the pelvic bone and the size and form of the femur, which possibly may in some cases be wanting, as was probably the case in the Provincetown specimen above described.

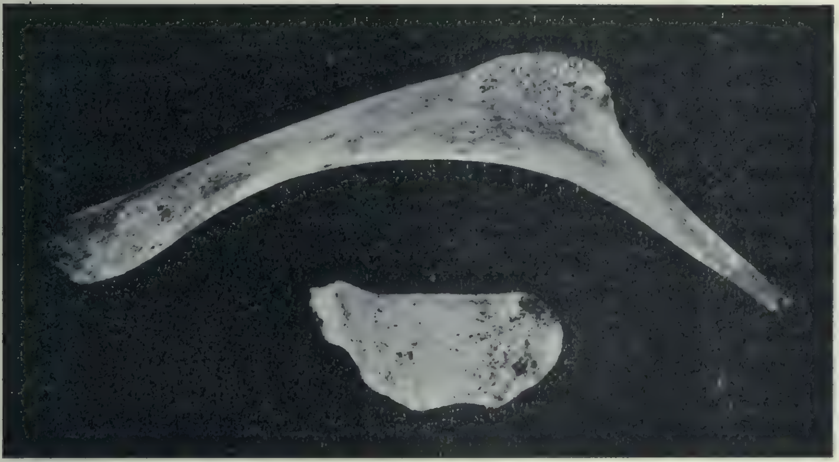
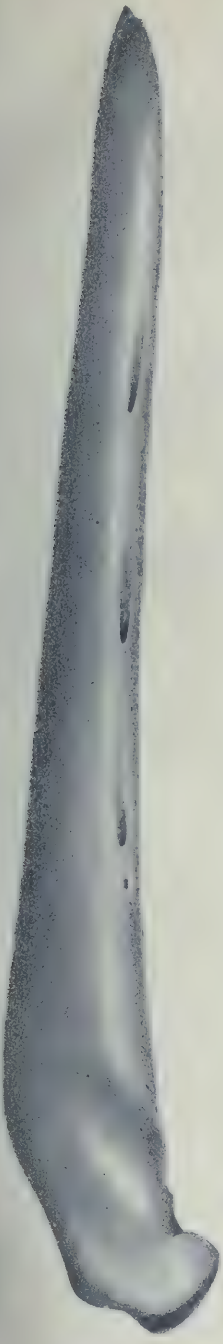


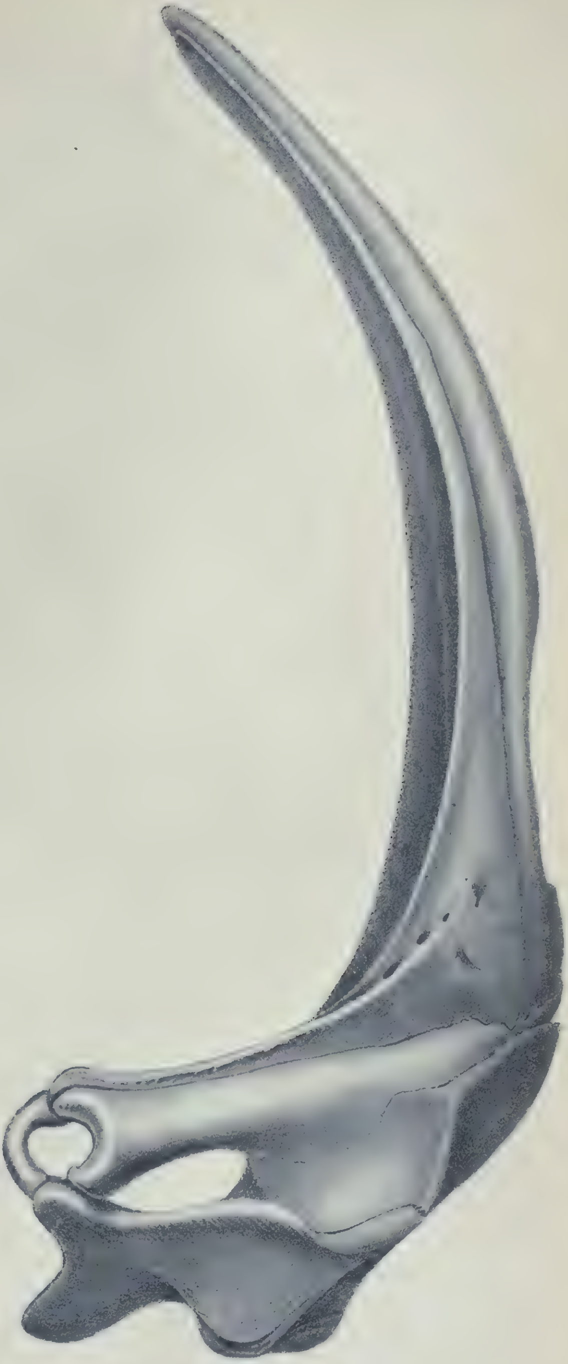
Fig. 1. Right pelvic bone, inner view, and vestigial femur of the large Amagansett Whale.

---

[1] On the Bones, Articulations, and Muscles of the Rudimentary Hind-Limb of the Greenland Right Whale (*Balæna mysticetus*). By John Struthers, M. D. Journ. Anat. and Phys., XV, 1881, pp. 141–176, 301–321, pll. xiv-xvii.

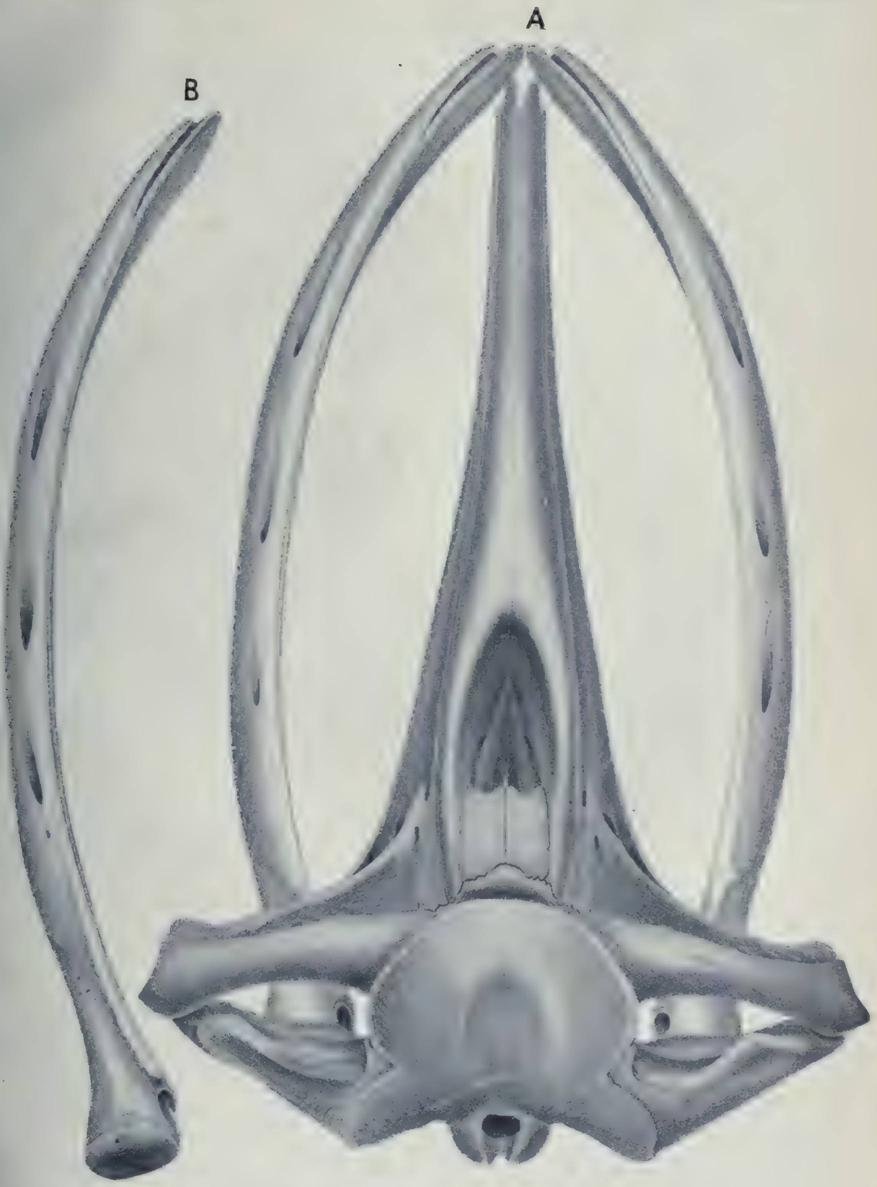
3 [illegible] 7



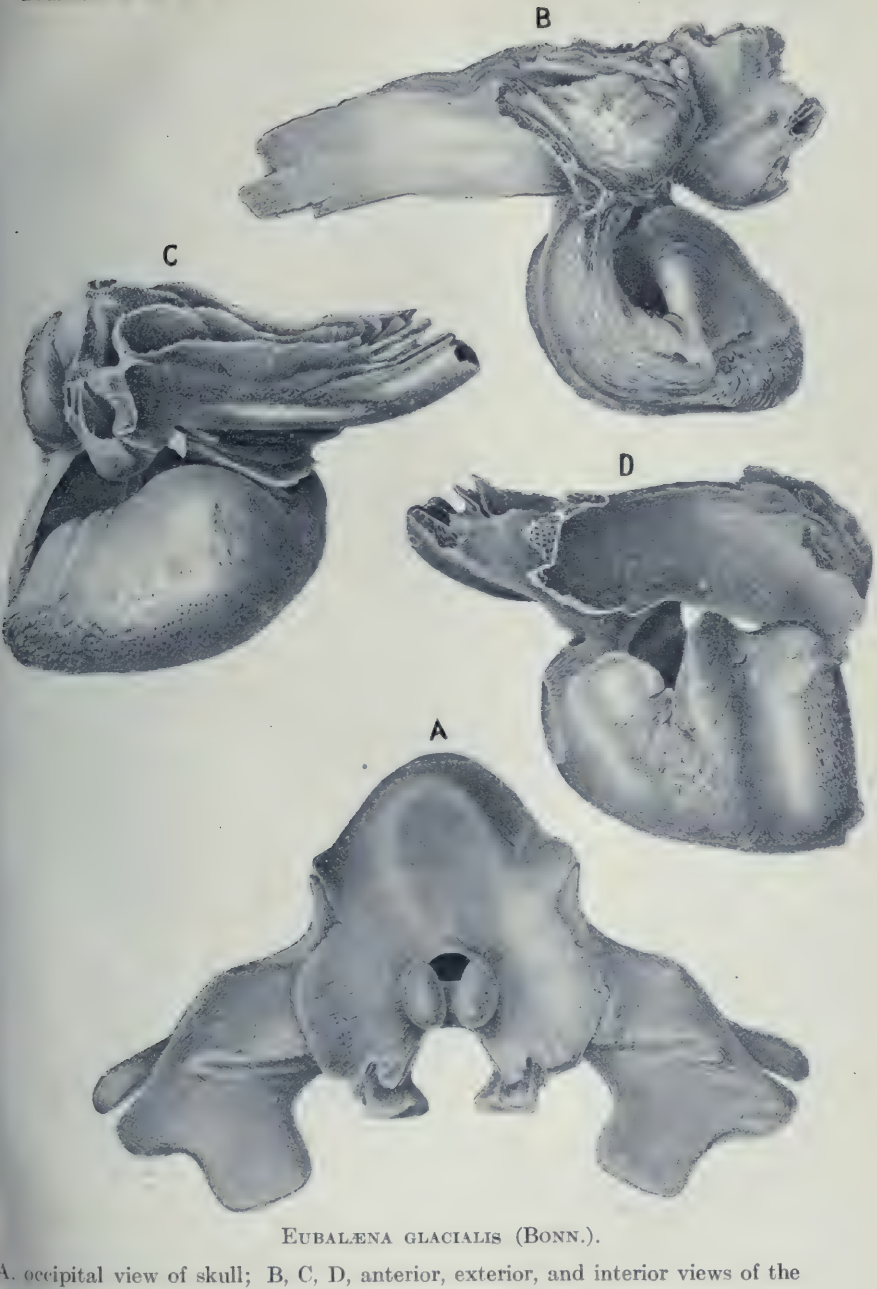


EUBALÆNA GLACIALIS (BONN.).

Skull and lower jaw, in profile.

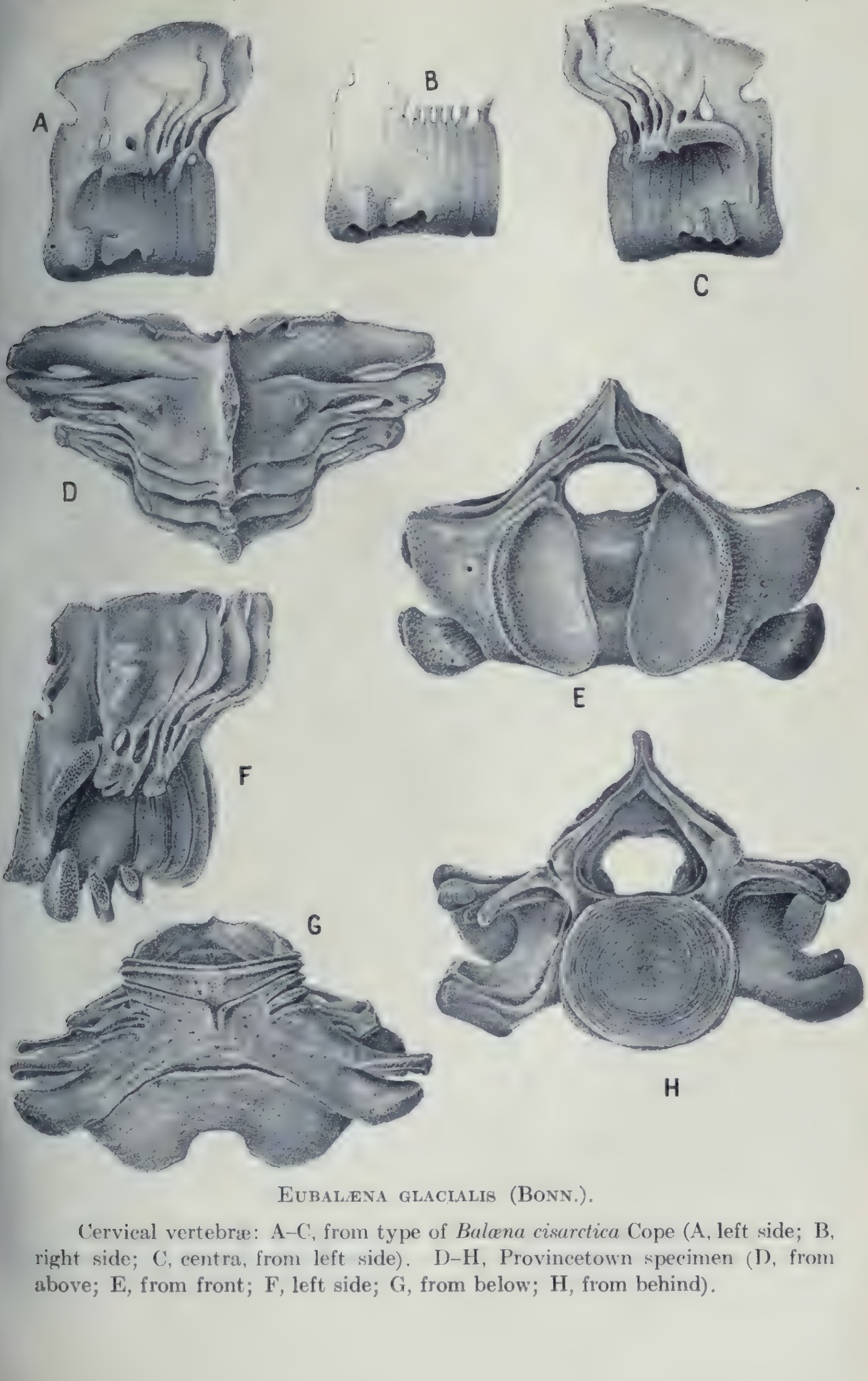


EUBALÆNA GLACIALIS (BONN.).
Skull and lower jaw, from above.



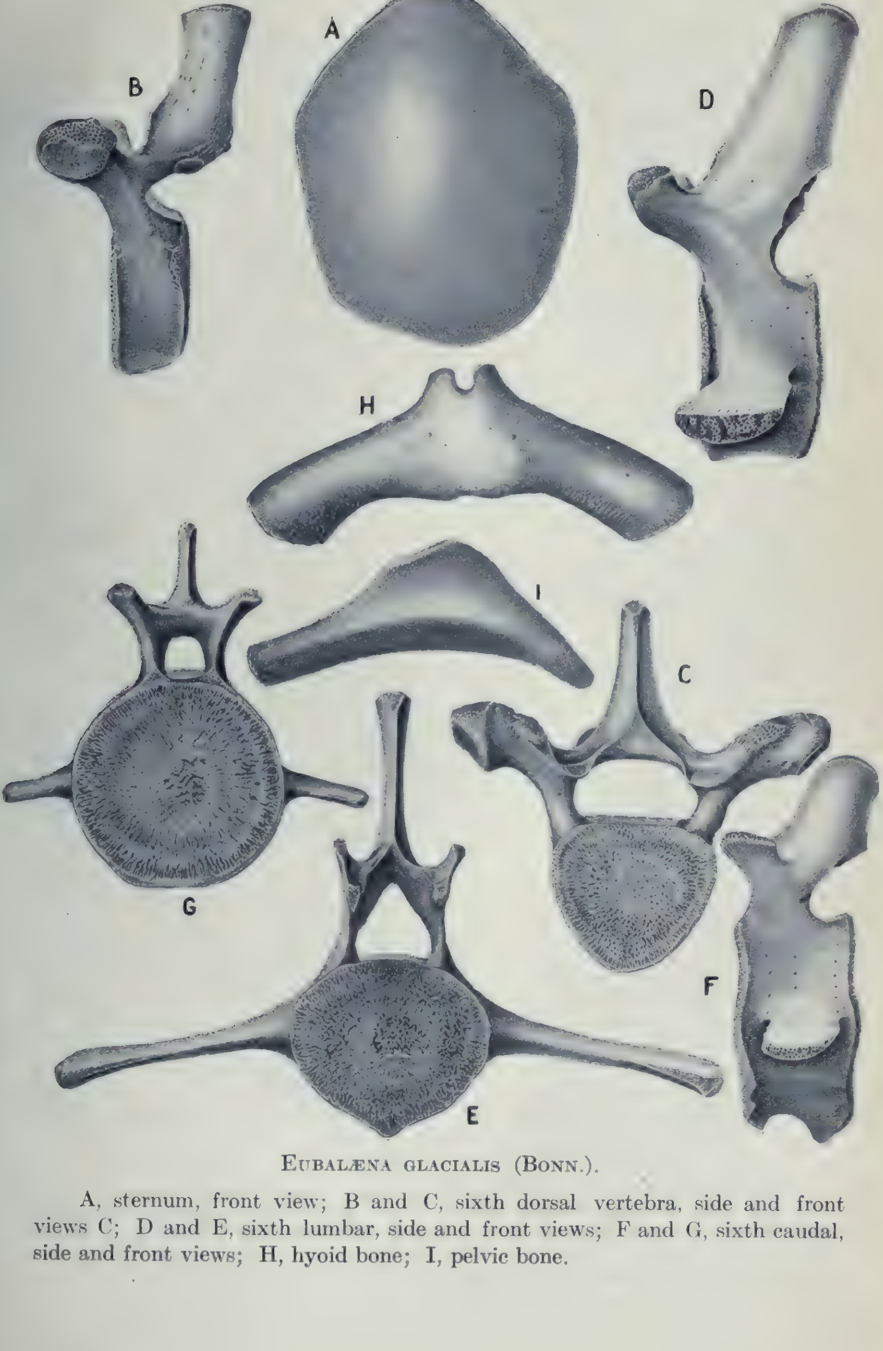
Eubalæna glacialis (Bonn.).

A. occipital view of skull; B, C, D, anterior, exterior, and interior views of the right ear-bone.



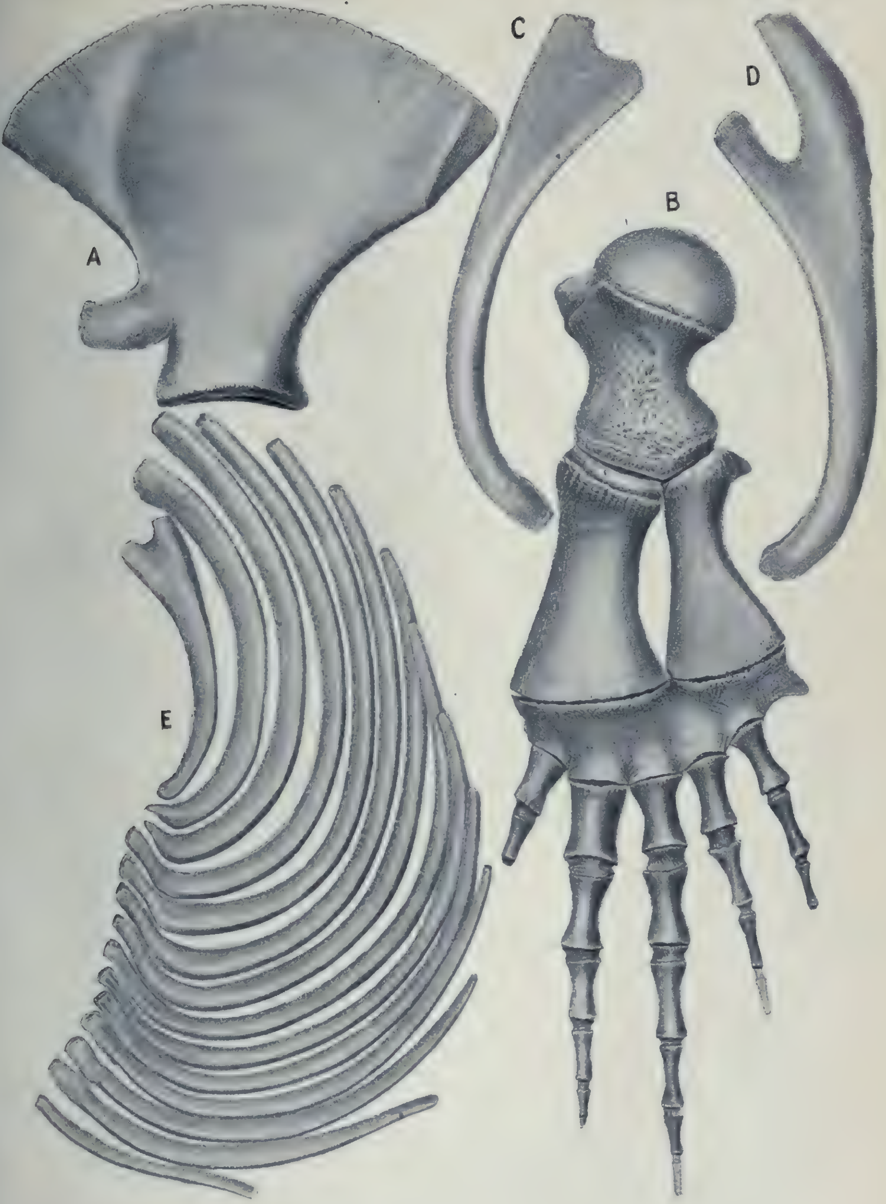
EUBALÆNA GLACIALIS (BONN.).

Cervical vertebræ: A–C, from type of *Balæna cisarctica* Cope (A, left side; B, right side; C, centra, from left side). D–H, Provincetown specimen (D, from above; E, from front; F, left side; G, from below; H, from behind).



Eubalæna glacialis (Bonn.).

A, sternum, front view; B and C, sixth dorsal vertebra, side and front views C; D and E, sixth lumbar, side and front views; F and G, sixth caudal, side and front views; H, hyoid bone; I, pelvic bone.



Eubalæna glacialis (Bonn.).

A, scapula; B, left pectoral limb; C, first rib, left side; D, first rib, right side; E, ribs of right side.

59.88;6 C

Article XIX.— A REVIEW OF THE MANAKINS OF THE GENUS CHIROXIPHIA.

By W. DeWitt Miller.

Plate XXV.

The genus *Chiroxiphia* is a small group of Manakins difficult to define by structural characters alone, on account of the great variations in external form among the several species, but well characterized by the coloration of the adult males, all of which have a blue back and a red or yellow crest. As usually understood, the genus consists of four well known and thoroughly established species: — *C. linearis*, *C. lanceolata*, *C. pareola*, and *C. caudata*. A fifth species, *C. regina*, is also recognized but its standing has recently been questioned. Two additional forms (*atlantica* and *boliviana*) are listed as subspecies of *C. pareola*.

In the present paper, eight species are recognized. *C. regina* is regarded as a valid species, the two forms commonly treated as subspecies are considered worthy of specific rank, and a new species allied to *C. pareola* is described. Reasons are given beyond, why the genus should not be broken up as has recently been done.

In the description of colors in this paper, Ridgway's 'Nomenclature of Colors' has been used. All measurements are in millimeters. The "width of bill" measurement is the width of the lower mandible at the anterior point of the bristles on its sides.

This paper is based upon the series of these birds in the American Museum of Natural History, and I am greatly indebted for the loan of additional material to the authorities of the United States National Museum, through Dr. Charles W. Richmond; to the Philadelphia Academy of Sciences, through Mr. Witmer Stone; and to Mr. Geo. K. Cherrie of the Brooklyn Institute of Arts and Sciences.

The eight species of the genus *Chiroxiphia* fall into four super-specific groups.

I.— The two northernmost species, *linearis* and *lanceolata*, the only ones reaching the Isthmus of Panama, differ from all the others in the form of the primaries, which are much broader, the outer five not conspicuously narrowed and not abruptly longer than the rest. The outermost primary is shorter than the first, instead of being equal to or slightly shorter than the sixth as in all other species. The central pair of retrices is more or less elongated and narrowed; the heel is perfectly bare.

II.— *C. pareola* and its three near allies form a group characterized by the plain, slightly rounded tail and the wide bill. The heel is bare. Pattern of coloration and form of crest as in Group I.

III.— *C. boliviana* is unique in the long, broad-feathered and strongly rounded tail and the narrow crest. The heel is feathered, and the bill is small and narrow.

IV.— *C. caudata*, the southernmost member of the genus, is remarkable for the form of the crest, which covers the entire pileum, and for the extension of the blue over the entire body, excepting the head and throat. The form of the tail is like that of section I; the heel is feathered as in section III; the bill is small and narrow.

The species are taken up beyond in their natural sequence as far as this can be expressed in a linear arrangement. This order also agrees with their geographic distribution, beginning with the most northern species. (See accompanying map.)

1. **Chiroxiphia linearis.**

Pipra linearis Bonaparte, Proc. Zool. Soc. Lond., 1837, 113 ("Mexico").
Pipra fastuosa Lesson, Rev. Zool., 1842, 174 (Realejo, Nicaragua).

Geog. Dist. Southern Mexico (Oaxaca and Chiapas), southward through Guatemala and Nicaragua to, at least, central Costa Rica.

This is the northernmost representative of the genus, and is the only species confined wholly to Mexico and Central America.

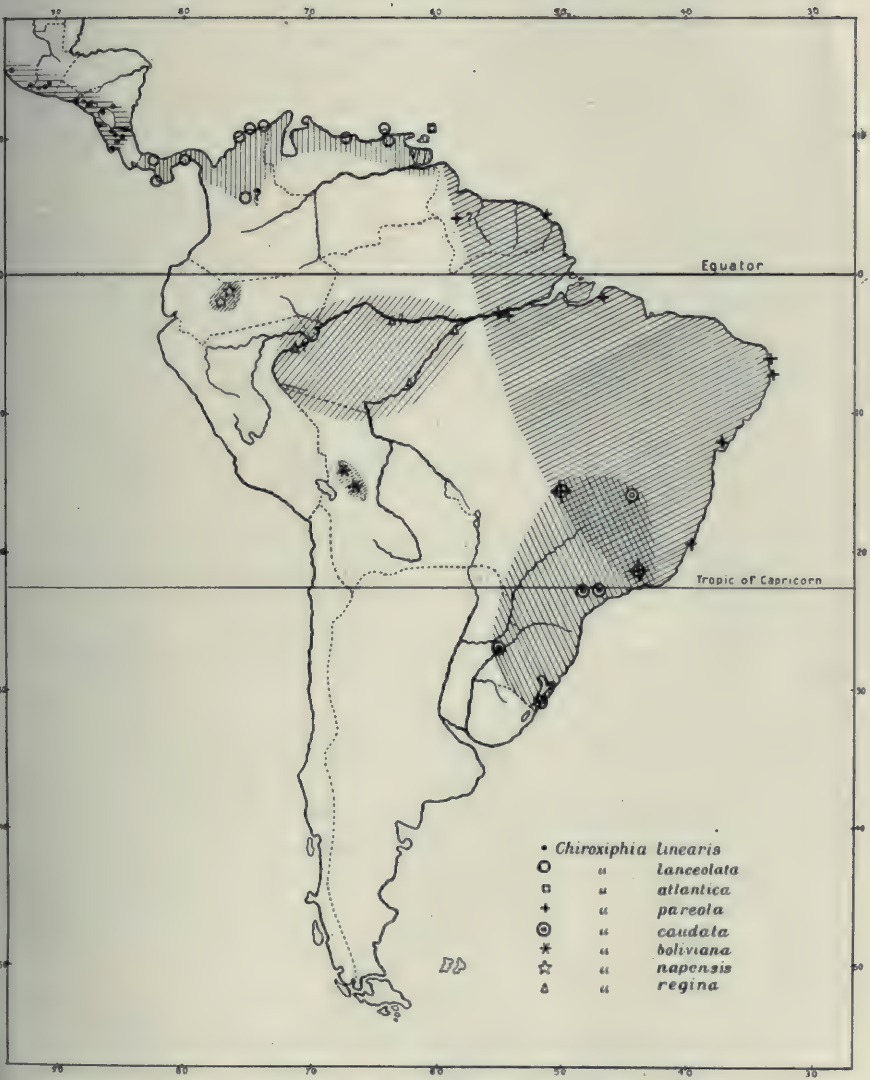
C. linearis closely resembles *C. lanceolata* in color but is well characterized by the form of the central pair of rectrices. These are narrowly linear and greatly elongated, particularly in the adult male, in which they project beyond the rest of the tail for a distance of four or five inches. On account of this peculiarity Bonaparte created the genus *Cercophæna*[1] with *C. linearis* as its type and only species.

The bill is black, and is small and narrow compared with that of the *pareola* group. The frontal feathers are decidedly elongated and erect, the anterior-most antrorse. The crest is crimson, averaging darker than that of any other species excepting *C. boliviana*.

The blue of the mantle is paler and more greenish than in any other species of the genus, but some specimens are practically identical with *C. lanceolata* in the shade of the blue.

---

[1] Consp. Voluc. Anisod., 1854, 6.


Equator
Tropic of Capricorn
90
80
70
60
50
40
30
10
0
10
20
30
40
50
• Chiroxiphia linearis
○ " lanceolata
▫ " atlantica
+ " pareola
◎ " caudata
✱ " boliviana
☆ " napensis
▵ " regina

Geographic ranges of the species of *Chiroxiphia*.

The under parts have been described as "intense black"; but while not of the strong "olive-slaty" cast of *C. lanceolata,* the plumage nevertheless looks dingy by the side of such deep black species as *C. pareola* or *C. atlantica.*

Mr. Ridgway states that of the series of this species examined by him the adult males from Nicaragua and Costa Rica invariably had longer tails and shorter and relatively narrower bills than those from southern Mexico and Guatemala. That the difference in length of tail is probably fortuitous is shown by comparing the following measurements given by Mr. Ridgway with those of the American Museum series:

3 adult males from Oaxaca	131.7
3 adult males, Chiapas (1) and Guatemala (2)	141
10 adult males, Nicaragua (2) and Costa Rica (8)	155.2
The American Museum series comprises:	
1 adult male from Oaxaca with tail	145
1 adult male from Guatemala	154
9 adult males, Nicaragua (8) and Costa Rica (1), 130–160, average	146.8

2. **Chiroxiphia lanceolata.**

Pipra lanceolata Wagler, Isis, 1830, 931 ("Guiana sive Cajenna").

Pipra pareoloides D'Orbigny & Lafresnaye, Rev. Zool., 1838, 165 (Cartagena, Colombia).

Geog. Dist. Panama, nearly or quite to the Costa Rican line, and northern and central Colombia and Venezuela.

This species is, in all its plumages, very similar to *C. linearis,* excepting in the form of the central rectrices, which, in *lanceolata,* project less than an inch beyond the others, and are lanceolate, tapering to a long and fine point. There is also a decided difference in the frontal feathering. This is less developed in the present species than in *C. linearis,* the black frontlet being narrower and the feathers less elongated. The bill is longer than that of the Long-tailed Manakin and relatively narrower, and is dark brown, not black.

The colors of the crest and back are intermediate in shade between those of *linearis* and *pareola,* but so similar to both that individual variation in the shades causes a complete overlapping of the three species in these characters. The red of the crest is almost identical in *lanceolata* and *pareola* but averages a trifle darker in the former. The specimens with the lightest and greenest backs agree with *linearis* in this respect, while those with the darkest and bluest mantles are very similar to *pareola.*

The under parts are less nearly black than in any other of the black-breasted species, being of a decided "olive-slaty" cast.

The females of *linearis* and *lanceolata* are almost indistinguishable in color of plumage, but the latter is usually a lighter and yellower green above. The crown is usually green or merely reddish tinged and the full red crest of the male is rarely acquired.

Bonaparte restricted the genus *Chiroxiphia* to two species, *C. caudata*, the type, and *C. lanceolata*. The latter, however, is much more closely allied to *C. linearis* and bears only a superficial resemblance to *C. caudata*, in the form of the tail.

The Trinidad records of *C. lanceolata*, accepted even by Mr. Ridgway in the recently issued fourth part of his great work,[1] are almost certainly erroneous, as no species of the genus is recorded from that island by Léotaud, nor did either Chapman or Cherrie meet with it. Dr. Hellmayr, in his list of the birds of Trinidad,[2] has entirely overlooked this Manakin, as no mention is made of it either among the species of known occurrence or in the list of those that have been wrongly accredited to the island. The absence of *Chiroxiphia* from Trinidad is a curious fact in distribution, as the genus is represented on the island of Tobago as well as on the adjoining mainland. Venezuelan specimens, as pointed out by Ridgway, are less black below than the average Colombian skin, having a strong "olive-slaty" tinge. But of four adult males from Panama (Boqueron, etc.), three are duller below than most Santa Marta birds and strongly washed with olive-green on the rump and flanks.

Three specimens (♂ ad., ♂ im., ♀ ad.) from Coiba (or Quibo) Island off the west coast of Panama, indicate the existence there of a slight insular form. Their bills exceed in size those of a majority of Panama and Colombian specimens. The blue of the adult male appears to be just appreciably darker and duller than in mainland birds, and the crest of this specimen is of maximum length. The female is distinctly darker than the typical form; the olive-green of the upper parts is a less golden-green, having less yellow in its composition. The shade of the upper surface agrees closely with that of the female of *C. linearis*.

These differences are probably too slight to necessitate the separate recognition of the island bird, but it is possible that a larger series might show the desirability of such separation.

---

[1] Birds of North and Middle America, Part IV, 1907, 738.

[2] Novitates Zoologicæ, XIII, No. 1, 1906.

3. **Chiroxiphia atlantica.**

Chiroxiphia pareola atlantica Dalmas, Mém. Soc. Zool. France, XIII, 1900, 139 (Tobago).

Geog. Dist. Island of Tobago.

Chiroxiphia atlantica is confined to the single small island of Tobago, lying immediately north of Trinidad, and is the only insular form of the genus. It is one of those species in which the characters are better developed in the female than in the male. The latter appears to differ from the same sex of *C. pareola* only in its somewhat greater size.

Unfortunately the series of available birds of these two species in the greenish plumage is poor and inadequate, few of the specimens having had the sex determined by the collector and many lacking dates. As nearly as I am able to judge from this material, however, the female of *C. atlantica* lacks the red crest or has it only imperfectly represented, while in *C. pareola* it is always (?) present and well developed. The latter, in fact, evinces a strong tendency to approach the adult male in plumage as shown by the frequent presence of more or less black on the head, and a bluish tinge to the dorsal plumage, as well as by the red crest. This tendency is apparently wanting in the Tobago bird, which is also of a lighter olive-green above and paler and yellower on the under surface. The five outer primaries are slightly broader than in the female of *pareola*.

The description of the female given by Dalmas [1] is difficult to understand, particularly the statement that the under surface is without yellow, as the three of four specimens seen by me all have a decided shade of yellow below, much more so than in *pareola*.

I am also unable to appreciate the differences said to exist in the plumage of the adult males. The red crest undoubtedly averages a trifle longer than in *pareola* but apparently the difference merely corresponds to the larger size of the bird; and the slightly greater extent of the black frontlet and blue mantle are due to the same circumstance.

The females of *atlantica*, although averaging rather smaller than the adult male in length of wing and tarsus, have a longer tail and larger bill. In *C. pareola* there is at least a tendency in the same direction.

Inasmuch as my material shows no intergradation and seems to indicate that complete overlapping of characters is improbable, it seems proper to treat *C. atlantica* as a full species. However, its specific distinctness is not here strongly insisted upon as it is quite possible that a larger and better series would give different results.

---

[1] "Femelle vert plus foncé sur le dos, sans teinte jaune sur le front ni sur la face inférieure." *Dalmas, l. c.*

4. **Chiroxiphia pareola.**

Pipra pareola LINNÆUS, Syst. Nat., ed. 12, I, 1766, 339 (Brazil, Cayenne).
Manacus superbus PALLAS, Spic. Zool., I, fasc. 6, 1769, 8 (pl. 3, fig. 1), Surinam; (coll. Mus. Geversianum).

Geog. Dist. Guianas, lower Amazon Valley, and eastern Brazil.

C. pareola has the most extensive distribution of any species of the genus. Its geographic range is in the form of a triangle, two sides of which are coincident with the Atlantic coast line, running from British Guiana southeast to Cape St. Roque and thence southwest to Rio Janeiro. It has been taken as far inland as Santarem and Obidos on the lower Amazon, some 500 miles from the ocean, and at Rio Claro, about 600 miles northwest of Rio Janeiro. South of the Amazon Valley I have found no records away from the coast or the large river valleys of the interior and it is possible that it may be absent from the great Brazilian plateau.

It may perhaps be regarded as the central species of the genus. Several distinct forms have been confused with it. These are compared with *pareola* under their respective heads. As now restricted there is no appreciable geographic variation, in either color or size, in this species.

The color of the crest in this species and in *C. atlantica*, described in the key as 'glowing light crimson,' cannot be matched by any of the shades in the 'Nomenclature of Colors.' It appears to be between scarlet and crimson.

5. **Chiroxiphia regina.**

Chiroxiphia regina[1] SCLATER, Ann. and Mag. Nat. Hist. (2), XVII, 1856, 469 (Borba, Brazil; coll. Vienna Mus.).

Geog. Dist. Upper Amazon Valley.

Chiroxiphia regina is a rare species in collections, and, so far as I know, there are no specimens in any museum in this country.

It is unique in the genus in possessing a yellow instead of a red or flame-colored crest. According to the original diagnosis by Mr. Sclater, and the very brief description in the British Museum Catalogue by the same authority, it differs from *C. pareola* in this respect alone, and for this reason Mr. Ridgway lately suggested that *regina* might possibly be only a color variation of that species.

Dr. Hellmayr's recent indorsement[2] of *C. regina*, however, should set at rest all doubts as to its validity. He records seven specimens, including females and both adult and immature males, collected on the Rio Madeira in 1907. No other species of the genus was taken by the collector. The females, I believe, are the first to be recorded. Dr. Hellmayr states that they "may be easily distinguished from those of the *C. pareola* races by their much darker and greener under surface." He fails to say whether or not the male has any specific character besides the color of the crest, but judging by the collector's notes, the feet are darker than those of *pareola*. The measurements given show that the yellow-crested species agrees closely in length of wing and tail with *pareola*. The crest is described as sulphur yellow by Taczanowski. Sclater's plate (Catalogue of American Birds) represents it as gamboge-yellow. Dr. Hellmayr mentions a difference in the shade of the crest and in the breadth of the black frontal band according to locality.

---

[1] Not *reginæ* as given by Ridgway (Bds. N. and M. Amer., Pt. IV, p. 736).
[2] Novitates Zoologicæ, XIV, No. 2, 1907, 361.

C. regina evidently has a definite geographic range, the great interior lowlands of Brazil, where it appears to replace the allied species. At least fourteen specimens have been recorded, all from the valley of the upper Amazons. The definite localities are as follows: Borba, Humaytha and Paraizo on the Rio Madeira, 'Lake' Manaqueri on the Rio Solimões, and Rio Javari, which separates Brazil and Peru.

A curious mounted specimen in the collection of the American Museum (Maximilian Coll.), an adult male from "Brazil," may here be mentioned. It agrees with *pareola* except that the crest is chrome, shot with red, mostly much paler than that normally present in *pareola*. This cannot be due to fading and the bird is either an actual intergrade between *regina* and *pareola* or, more likely, merely a variant of the latter.

6. **Chiroxiphia napensis** sp. nov.

PLATE XXV.

Chiroxiphia pareola (not *Pipra pareola* Linn.) SCLATER, Cat. Birds Brit. Mus., XIV, 1888, 307, part (Sarayacu, Ecuador); ALLEN, Bull. Am. Mus. Nat. Hist., March, 1889, 72 (Napo, Ecuador).

Specific Characters.— Similar to *C. pareola* but darker, with lighter crest. General size slightly smaller, bill larger.

Type No. 30459, Am. Mus. Nat. Hist., ♂ ad, Napo, Ecuador, L. Söderström.

Geog. Dist.— Headwaters of the Rio Marañon, Ecuador, (Napo, Sarayacu).

In the collection of the American Museum there are four specimens of a *Chiroxiphia* from Napo, Ecuador, that evidently represent a hitherto undescribed form.

They differ from *C. pareola* in slightly smaller size, with relatively larger bill; the feet are darker and the upper anterior end of the tarsus is more feathered. The general coloration is deeper, but the crown patch is a lighter, more orange red and less emarginate posteriorly.

In the adult males the back is of a considerably deeper blue. A single unsexed bird in the greenish plumage with red crest, probably an adult female, is much darker than any of the skins of *pareola*, especially on the under surface.

C. napensis is separated geographically from *C. pareola*, with which it has heretofore been united, by an immense area of country inhabited by other species. Its relationship to *C. regina* which lies immediately to the eastward and between *napensis* and *pareola*, may be closer than is at present evident. The orange shade of the crest, the dark plumage of the female, and probably the deeper color of the feet, are an approach to the characters of *C. regina*. The dark blue mantle of the male may be another indication of affinity, for in the colored plate of *regina* published in Sclater's 'Catalogue of American Birds,' the mantle is represented as of a deeper shade than in *pareola*.

As no intergradation is known to take place between *napensis* and its allies, it has seemed best to give this new form full specific rank. Two adult males recorded in the 'Catalogue of Birds in the British Museum' from Sarayacu, Ecuador, which lies about sixty-five miles south-southwest of Napo, doubtless belong to this species.

7. **Chiroxiphia boliviana.**

PLATE XXV.

Chiroxiphia pareola (not *Pipra pareola* Linn.) SCLATER & SALVIN, Proc. Zool. Soc. Lond., 1879, 617 (Nairapi, Tilotilo, Prov. Yungas, Bolivia); SCLATER, Cat. Birds Brit. Mus., XIV, 1888, 307, part (same localities as given above).

Chiroxiphia pareola boliviana ALLEN, Bull. Am. Mus. Nat. Hist., II, March, 1889, 87 (6000 feet altitude, Prov. Yungas, Bolivia).

Geog. Dist. Headwaters of the Rio Beni, Department of La Paz, Bolivia.

The earliest record for this species seems to be in the 'Proceedings' of the Zoölogical Society of London for 1879, where Dr. Sclater recorded several specimens from Bolivia under *C. pareola*. They were said to "agree with Brazilian skins [of *pareola*] except in having the crest rather narrower and of a somewhat deeper color." Ten years later Dr. Allen very properly separated the Bolivian form on the strength of a single rather poor specimen from Yungas (dated Sept. 1885), naming it *C. p. boliviana*.

Besides the type I have seen two other specimens, a fine adult male collected by Mr. R. S. Williams at Santa Cruz, near Apolobamba, on Aug. 26, 1902, and presented by him to the American Museum, and a similar specimen in the collection of the National Museum from Quebradaonda,[1] taken by G. Garlepp, on June 20, 1892. Both agree closely with the type and emphasize the distinctness of *boliviana.* Indeed so strongly characterized does this form prove to be that there cannot be the slightest doubt of its full specific value.

The salient characters of this excellent species are the small and narrow bill, with all the outlines less curved than in *pareola* or *napensis;* the feathered heel-joint, and particularly the long, broad-feathered and strongly rounded tail. The outer rectrices are 8.5 or 9 mm. wide as compared with 6 to 7 in the above species, and are relatively broader towards the tip. Good additional characters are the great backward extension of the black frontlet, and the very narrow, dark crimson crest, the individual feathers of which are truncate rather than rounded or pointed as in the other species. The mantle is a *dull grayish* azure and somewhat less extensive than in allied forms. The rictal bristles are unusually well developed, and, as in *napensis,* the feet are more deeply colored than those of *pareola.*

These differences trenchantly separate *boliviana* from its nearest relatives, the two species above mentioned, and the possibility of intergradation taking place between them is too remote to need consideration. The geographic ranges of both this species and *C. napensis* as far as known are much more restricted than those of any other of the continental forms.

Unfortunately I have seen neither the female nor the young male of *C. boliviana.* Both are recorded under *C. pareola* in the British Museum Catalogue.

The comparatively long tail of this species is a step in the direction of the monotypic genus *Antilophia* of southwestern Brazil and eastern Bolivia. The latter appears to be nearer *Chiroxiphia* than its present position in the books indicates. In its own range it evidently replaces *Chiroxiphia,* for the Smith Collection of Matto Grosso birds contains a large series of *Antilophia galcata* but not a specimen of the related genus.

8. **Chiroxiphia caudata.**

Pipra caudata Shaw, Nat. Misc., V, pl. 153 (1794).
Pipra longicauda Vieill., Nouv., Dict., XIX. p. 163 (1817).
Pipra viridis Thunberg, Mém. Acad. Imp. Sci. St. Pétersb., VIII, 1822 (female).
Pipra ignicapilla Wagler, Isis, XXIII, 931 (1830).

Geog. Dist. Southern Brazil, Paraguay, and northern Argentina.

---

[1] This locality I have been unable to find on any map but believe it to be in the same general region as the other localities.

This very distinct species is the type of the genus *Chiroxiphia*. It is the southernmost in distribution not only of the genus but, I believe, of the entire family. The northern part of its range overlaps the extreme southern part of the area inhabited by *C. pareola*. Instead of the truncate or emarginate vertical crest of the other species, *C. caudata* has a full globular crest covering the entire pileum.

In his recent treatment of the family Mr. Ridgway restricts *Chiroxiphia* to *C. caudata*, using Bonaparte's name *Chiroprion* for all the remaining species. The characters used to divide the genus are the differences in form of the crest and frontal feathers, and the supposed discrepancy in the extent of feathering of the tibio-tarsal joint. Even did the latter character hold, the desirability of recognizing *Chiroprion* would certainly be doubtful. But as *C. boliviana*[1] is found to have the heel-joint feathered as in *C. caudata* only the differences in the coronal feathering and in coloration remain, characters surely insufficient of themselves to separate the species generically.

If *Chiroprion* is separated it is impossible to consistently deny recognition to Bonaparte's other genus *Cercophæna*, to include *linearis* and *lanceolata*, and to create a new genus for *C. boliviana*. It seems far better to regard these differences as of only specific or subgeneric value and to leave the genus *Chiroxiphia* with its usually accepted limits.

The following key to the species of the groups in which the central rectrices are not elongated, applies to the adult and subadult males only. The series of females at hand is so imperfect that it has been thought best not to attempt to include them in the key.

Key to the Species.

a. Tail *more* than three-fifths as long at wing exceeding 44 mm. in length; width of bill at base *less* than width of outer rectrix; extreme lower end of tibia concealed by feathers; crest dark crimson, very narrow, scarcely or not wider than the very broad (anteroposteriorly) black frontlet; back dull grayish azure. (Bolivia.) ....*Chiroxiphia boliviana*.

aa. Tail *less* than three-fifths as long as wing, *less* than 44 mm. in length; width of bill at base *greater* than width of outer rectrix; extreme lower end of tibia not concealed by feathers posteriorly; crest glowing *light* crimson to yellow, broad, much wider than the moderately broad black frontlet; back azure (lighter or darker).

  b. Crest red.

    c. Larger, with relatively smaller bill, wing usually exceeding 70 mm. (69.2–77.4), tail usually exceeding 33.5 mm. (33.2–40.5), width of bill at base 7.6–9 (av. 8.2), crest glowing, light crimson, decidedly emarginate posteriorly; back light azure; feet pale.

---

[1] This species had not been seen by Ridgway at the time he divided the genus.

d. Smaller, wing 69.2–75 (71.2), tail 33.2–36.4 (av. 34.6). (Northeastern and eastern South America).
Chiroxiphia pareola.

dd. Larger, wing 75.–77.4 (av. 76.1), tail 38.5–40.5 (av. 39.5). (Island of Tobago)..............*Chiroxiphia atlantica.*

cc. Smaller, with relatively larger bill, wing usually less than 70 mm. (68–70.5), tail usually less than 33.5 mm. (31.5–32.8), width of bill at base 8.5–8.8 (av. 8.6); crest scarlet-vermilion, scarcely emarginate posteriorly; back dark azure; feet dark. (Ecuador).
Chiroxiphia napensis.

bb. Crest yellow (Valley of upper Amazons)..........*Chiroxiphia regina.*

In the following tables of measurements, the first table gives the measurements of *C. pareola* from different parts of its range. The single large "Bahia" bird, a 'Museum Boucard' specimen without original label, is omitted from the final measurements because of the belief that it may in reality have come from Tobago. Four mounted specimens of *pareola* from Brazil (2 adult males and 2 immature males, or more likely females), the measurements of which are not given below, agree well with the series from Brazil here recorded.

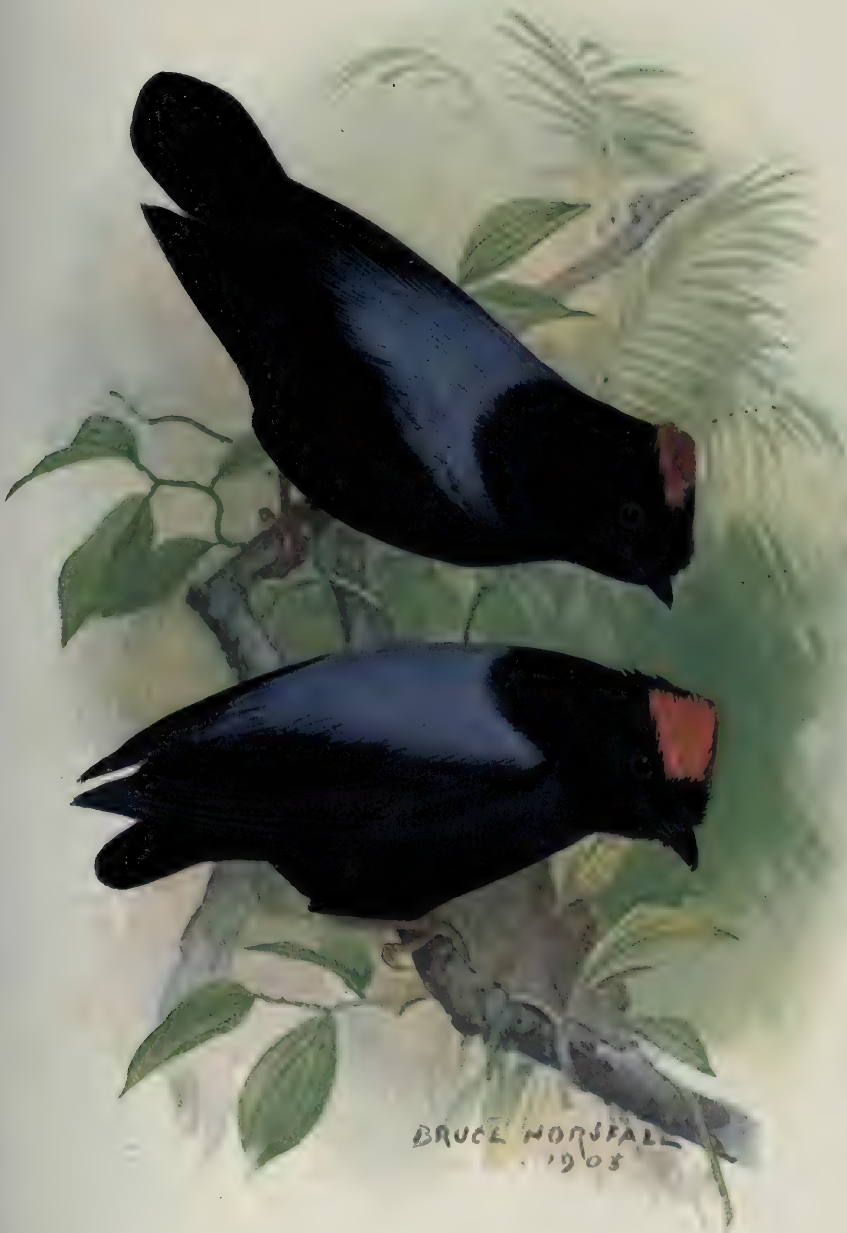
The accompanying map shows the geographic ranges of the eight species of the genus as worked out from all available specimens and published records. Interrogation points indicate that the position of the locality is in doubt, either because it has been impossible to find it on any map or because the records fail to give the exact locality.

Measurements of Adult and Sub-adult Males.

No. of Specimens	Locality.	Wing.	Tail.	Tarsus.	Length of bill from nostril.	Breadth of bill at base.
4	British Guiana	69.2(70.7)71.8	33.5(34.5)35.6	17.4(18.1)18.5	5.7(5.9)6	7.6(8.1)8.3
2	French Guiana	69.2(72.1)75.	33.2(33.9)34.6	17 (17.8)18.5	5.7(5.9)6	8.1(8.3)8.5
2	Vic. Santarem, Brazil	70.1(70.4)70.6	34.4(34.6)34.7	18.3(18.4)18.4	5.7(6.)6.2	8. (8.1)8.1
7	Bahia, Brazil	70.5(71.4)72.5	33.8(34.8)36.4	17 (18.1)19	5.4(5.7)6	7.6(8.)8.5
1	"Bahia" ?	76.8	39	19	6.3	8.1
7	*atlantica*	75 (76.1)77.4	38.5(39.5)40.5	19 (19.7)20.2	5.9(6.3)6.6	8 .(8.5)9
15	*pareola*	69.2(71.2)75	33.2(34.6)36.4	17 (18.1)19	5.4(5.8)6.2	7.6(8.1)8.5
3	*napensis*	68 (69.2)70.5	31.5(32.)32.8	17.3(17.6)18	5.7(6.2)6.5	8.5(8.6)8.8
3	*boliviana*	68 (69.8)71	47.5(47.5)47.5	17.4(17.8)18	5.4(5.5)5.6	6.2(6.6)7

Measurements of Females and Young Males.

3 ♀	(green crest) *atlantica*	72.2(73.5)75	40 (41.3)42	18.5(18.8)19	6.5(6.8)7	8.2(8.7)9
1 ?	(imperfect red crest) *atlantica*	72	41.5	19.5	7	8.6
1 "♂ jv."	*atlantica*	71.2	39.3	19.5	6.4	8.6
5 ♀ & ♂ jv.	*atlantica*	71.2(72.7)75	39.3(41.)42	18.5(19.1)19.5	6.4(6.7)7	8.2(8.6)9
11 " "	*pareola*	65 (69.2)73	32.5(34.2)35.5	17.1(17.9)18.7	5.3(5.9)6.4	7.5(8.1)8.7
1 ♀ ?	*napensis*	68	31.5	18	6.3	8


BRUCE HORSFALL
1905

Chiroxiphia boliviana.
Chiroxiphia napensis.

59.57,96:15

Article XX. — HONEY ANTS, WITH A REVISION OF THE AMERICAN MYRMECOCYSTI.

By William Morton Wheeler.

Introduction.

For several years specimens of our American species of *Myrmecocystus* have been accumulating in my collection, and at various times I have devoted considerable attention to the habits of these remarkable ants in the arid lands of Texas, New Mexico, Arizona and Colorado. This material and these observations prove not only that the accounts of previous writers are very fragmentary but that the problems suggested by our *Myrmecocysti* are much more complicated than has been supposed. Since I may be unable to continue my field work on this group for some time to come, and since the preparation of a chapter on the honey ants for a forthcoming book has compelled me to examine the pertinent literature and the specimens in my collection with some care, I have decided to publish the following account of the material in hand.

Our *Myrmecocysti* present both taxonomic and ethological difficulties. We seem to have only two species, and these are closely related, but each is represented by several still more closely related geographical races, or subspecies and varieties. Although in part recognized by European myrmecologists, these subspecies and varieties have not been accurately defined. Such definition, indeed, could hardly be expected, for this is impossible without extensive studies in the field, because the workers of the same colony sometimes vary greatly in size and color and in some cases even tend to become dimorphic. Another difficulty, which seems not to have occurred to previous observers, arises from the fact that the extraordinary habit of producing honey-storing repletes, rotunds, nurses, or plerergates, as they have been designated by different writers, seems to be entirely absent in certain forms of both species, and that even in the forms in which it has been observed, this habit may, perhaps, be manifested only in particular localities or during certain seasons. These considerations tend to complicate the matter of classification, since the question must arise as to the taxonomic value of the presence or absence of this particular habit.

The ants of the genus *Myrmecocystus* are confined to the warmer and more arid portions of Europe, North Africa, Central Asia and Southwestern North America (Fig. 1). In these xerothermic regions they may be said to take the place of the more moisture-loving species of *Formica*, to which they are very closely related. In fact, the two genera differ only in certain minor characters, such as the greater length in the worker and female *Myrmecocystus* of the fourth as compared with the fifth joint of the maxillary palpi and the more parallel frontal carinæ. In many, but not in all, species of the genus the wings of the male lack the discoidal cell, but this is present in the females. Comparison shows that there are certain striking differences between the Old World and North American species. The males of the American forms are small, resemble those of *Lasius* and have very simple genitalia. The workers and females have gular but no mental ammochætæ. In the Old World species the males are much larger and more like those of *Formica*, with more complicated genital valves, and the ammochætæ of the workers and females are developed as a tuft on the mentum and are absent on the gula. All of the Old World species are, moreover, highly carnivorous, whereas those of the New World have a varied diet: some being excessively carnivorous, while others, at least during certain seasons, are aphidicolous or feed on the sweet excretions of plants. Forel, many years ago (1886), called attention to some of these differences between the palearctic and nearctic *Myrmecocysti*, and concluded that we ought, perhaps, to separate the latter, "retaining for them the name *Myrmecocystus* and reëstablishing the genus *Cataglyphis* Foerster for the other species." He hesitated to do this, however, because the female of *M. melliger* and *æneovirens*, and the worker and female of *Formica oculatissima* and *aberrans* were unknown and the winged sexes of *M. bombycinus* were imperfectly known. *M. æneovirens* has since been consigned to the genus *Melophorus*, and the winged sexes of certain forms of *M. melliger* have now been found. As they differ very little from those of *M. mexicanus* I believe that *Cataglyphis* should be reinstated, at least as a subspecific name.

Our North American *Myrmecocysti* are known to range over the arid plains and deserts of the southwest from the City of Mexico to Denver, Colorado. Of the two species, *M. melliger* is the more abundant at lower altitudes of about 300–1500 m., whereas *mexicanus* seems to find its optimum environment at about 2000–2500 m.

The earlier descriptions of these species are so meager that for a long time there was much misunderstanding in regard to their identity. Llave in 1832 first described a *Myrmecocystus* under the name of *Formica melligera* from specimens taken near the City of Mexico, but it is impossible to determine which of the species he had under observation, and there are no types in existence. In 1838 Wesmael described some ordinary workers and repletes of a Mexican ant as *Myrmecocystus mexicanus*. His types have been preserved and one of these was examined by Emery (1893), who thus succeeded in establishing the identity of the species. Forel (1886) had previously seen specimens of a different *Myrmecocystus* taken in Texas (Collection de Saussure) and Mexico (Museum of Lyons) and had described it as *M. melliger,* believing that it was the species described by both Llave and Wesmael and that only one species existed. It is therefore necessary, as Emery has shown, to cite Forel and not Llave as the authority for *melliger.* Until the existence of two species had been established, the synonymy was in great confusion, and is still in that condition in Dalla Torre's 'Catalogus Hymenopterorum' (VII, 1893, pp. 217, 218). I give my interpretation of the references in connection with the following brief descriptions of the different forms, but many of the allusions of the earlier authors, especially those to Llave's *Formica melligera* must forever remain doubtful. Good specimens of the typical *melliger* and *mexicanus* seem to be rare in collections, and the males and females of these particular forms are still unknown. Nor have any full and accurate observations been published on their habits. For the present, therefore, we shall have to be content with the old accounts of Llave, Lucas and Wesmael, with McCook's much more satisfactory observations on a variety of *mexicanus,* and with my field notes on several of the forms of both species observed in the southwestern states.

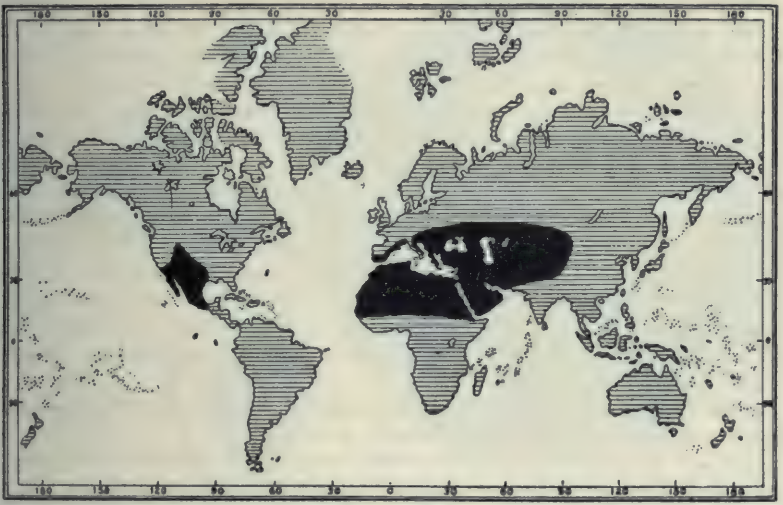


Fig. 1. Map showing (in black) the distribution of *Myrmecocystus sensu stricto* in North America and of the subgenus *Cataglyphis* in the Old World.

PART I. DESCRIPTIONS OF AMERICAN MYRMECOCYSTI.

1. **Myrmecocystus melliger** *Forel.*

(Fig. 2.)

?*Formica melligera* LLAVE, Reg. Trim. o Collect. Mem. Hist. Lit., 1832, p. 463, ☿.
Myrmecocystus melliger FOREL, Ann. Soc. Entom. Belg., XXX, 1886, p. 202, ☿ (exclus. synonymy); EMERY, Zool. Jahrb., Abth. f. Syst., VII, 1893, pp. 666, 667; FOREL, Biol. Central. Amer., Hymenopt., III, 1899–1900, p. 130; DALLA TORRE, Catalog. Hymenopt., VII, 1893, p. 218 (in part).

Worker major.— Length 8–9 mm.

Head rather large; excluding the mandibles, about as broad as long, a little narrower in front than behind, with rounded posterior corners and somewhat rounded or convex sides. Eyes small, less than $\frac{1}{5}$ as long as the side of the head. Clypeus broad, convex in the middle, but not carinate, with broadly rounded but not projecting anterior border. Frontal area large, triangular, its outline indistinct behind. Frontal groove replaced by a rather indistinct ridge or raised line. Mandibles large, 7-toothed, with the apical tooth long and curved. Antennæ slender. Last joint of maxillary palpi but little more than $\frac{1}{2}$ as long as the penultimate joint. Thorax long, constricted in the mesonotal region; in profile low and depressed above. Epinotum, when seen from above, broad, truncated behind; in profile with subequal base and declivity, meeting at a rounded and very obtuse angle. Petiole lower than the epinotum and about half as broad, thick, very blunt above, with a faint median impression. Gaster rather large, broadly elliptical, somewhat flattened above. Legs long.

Surface of body very finely punctate and shagreened; feebly shining, head more glabrous. Mandibles coarsely longitudinally striated.

Hairs and pubescence grayish, the former erect, rather abundant and covering all parts of the body, including the maxillary palpi, legs and antennal scapes. Pubescence dense on the gaster, petiole, thorax and legs, so that these parts have a silky luster, much shorter and sparser on the head, so that its shining surface is exposed.

Head and anterior portion of thorax yellowish red. Posterior portion of thorax, petiole, and legs more brownish red; gaster black but appearing gray on account of the layer of pubescence. Mandibular teeth and anterior border of clypeus blackish.

Replete.— Length 9–12 mm.

In all respects like the worker major except in having the gaster filled with honey and dilated to form a translucent sphere, as large as a pea (6–8 mm. in diameter), on the surface of which the sclerites appear as isolated dark patches separated by the tense, pellucid, yellowish intersegmental membrane.

Worker minor.— Length 4.5–5 mm.

Resembling the worker major, but with the head distinctly longer than broad, as broad in front as behind and with straight, subparallel sides. Color deeper, the red of the head, anterior portion of the thorax and legs being duller and more brownish.

Mexico: Guanajuato (Dugés), City of Mexico (Flohr), Matamoras (Langstroth), El Moral, Ciudad Porfirio Diaz (seven repletes from S. F. Rangel); Chilicote, Chihuahua (three ordinary workers from C. H. Tyler Townsend).

Texas: (Forel); Brownsville (Langstroth), El Paso (one worker, Am. Mus. Nat. Hist. Coll.).

The repletes from El Moral agree very closely with Forel's description. I am not so certain that the other specimens belong to the typical *melliger*. This form is distinguished from *mexicanus* by its small and more mesially placed eyes, broader head in the worker major and darker color. Unfortunately both the female and male are unknown.

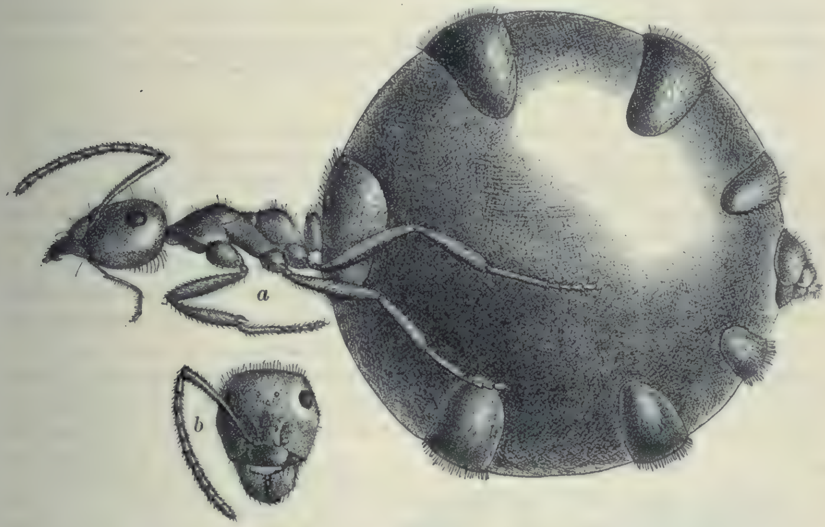


Fig. 2. *Myrmecocystus melliger* Forel, *a*, replete; *b*, head of same from above ×8.

2. **Myrmecocystus melliger orbiceps** subsp. nov.

(Fig. 3.)

Wheeler, Biol. Bull., XIII, 4, 1907, p. 200, fig. 11, ☿.

Worker major. Length 7–8 mm.

Head fully as broad as long, orbicular, with much inflated and rounded cheeks. In other respects the structure of the body is like that of the typical form.

Surface finely and rather irregularly reticulate-punctate, opaque, except the head, which is shining. Mandibles coarsely longitudinally striated. Clypeus with a few scattered piligerous punctures.

Hairs and pubescence silver gray, the former erect, abundant, but rather short, slender and tapering; the latter long, very dense on the gaster, where it completely conceals the surface, somewhat shorter and less abundant on the thorax and legs and much less abundant on the head where the shining surface is exposed. The erect hairs on the antennal scapes and legs are usually abundant and very conspicuous though shorter than those on the body.

Rather vivid yellowish red, passing into brownish red on the epinotum, petiole, middle and hind coxæ and tips of the antennal funiculi. Gaster blackish but appearing silver gray and glossy on account of the dense pubescence.

Worker minor. Length 4–6.5 mm.

Head longer than broad, hardly broader behind than in front, with straight subparallel sides. Eyes relatively a little larger than those of the worker major, and antennæ more slender. Head less shining. Hairs and pubescence like those of the worker major, but somewhat shorter. Only the head yellowish red; the remainder of the body and the legs blackish; pronotum reddish in larger specimens.

Female. Length 11–12 mm.

Head rectangular; without the mandibles, as broad as long, with straight subparallel sides and straight posterior border. Eyes rather small, not more than $\frac{1}{5}$ as long as the side of the head. Last joint of maxillary palpi not more than $\frac{1}{2}$ as long as the penultimate joint. Thorax robust, through the wing insertions a little broader than the head, elliptical, nearly twice as long as broad, flattened above. Epinotum rounded, sloping, without distinct basal and declivous surfaces. Petiole compressed anteroposteriorly, with flat anterior and posterior surfaces and a blunt border, which is notched in the middle. Gaster broadly elliptical, somewhat flattened. Wings long (13–13.5 mm.), with large discoidal cell.

Sculpture, pilosity and pubescence similar to those of the worker major, but the thorax above is shining, like the head, and the hairs and pubescence are longer and more abundant on all parts of the body and especially on the head. The punctures on the head and mesonotum are coarser and the clypeus is covered with scattered foveolæ.

Blackish; with the pronotum and sides of the thorax suffused with red; head paler red but darker than in the worker. Legs and antennæ dark red. Gaster appearing silvery gray on account of the dense pubescence concealing the black ground color. Wings hyaline with yellow veins and stigma and the membranes suffused with yellow along the costal margin.

Texas: Type locality: Bull Creek, near Austin (Brues, Melander, Wheeler); other localities: San Antonio, Marble Falls, San Angelo, Barksdale, Ft. Stockton, Langtry, Del Rio (Wheeler); Laredo (J. F. McClendon).

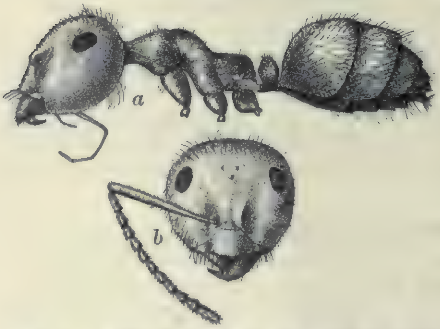


Fig. 3. *Myrmecocystus melliger orbiceps* subsp. nov., *a*, worker major in profile; *b*, head of same from above. × 7.

New Mexico: Alamogordo (H. L. Viereck, G. v. Krockow, A. G. Ruthven).

Arizona: Ash Fork and Tucson (Wheeler); Cochise County, 300–1500 m. (C. R. Biedemann).

This subspecies is certainly distinct from the typical *melliger* and is readily recognized by its more abundant and more silvery pubescence and pilosity, and the peculiar orbicular head of the worker major, which is sharply separated from the long-headed minor workers and may be compared with the singular soldier of the north African *M. bombycinus*, although the orb-headed form occurs in greater numbers in the colony.

3. **Myrmecocystus melliger mendax** subsp. nov.

(Fig. 4.)

Worker major. Length 6–7 mm.

Differing from the worker major of *orbiceps* as follows: Head smaller and rectangular, as broad as long, excluding the mandibles, with straight, subparallel sides, straight posterior border and rounded posterior angles. Cheeks not inflated. Color of the head a duller red and the infuscation of the thorax deeper, extending further forward and involving the pronotum. Silvery gray pubescence somewhat less abundant and erect hairs stouter and more obtuse, especially on the gaster.

Worker minor. Length 4–5.5 mm.

Like the corresponding form of *orbiceps*, except that the head is dark red behind, the hairs more obtuse and the pubescence somewhat sparser.

Female. Length 9–10 mm.

Resembling the female of *orbiceps* but with the thorax yellowish red, like the head, with the epinotum, pleuræ behind and below, and clouds on the parapsides and anteromedian portion of the mesonotum, fuscous. The legs, too, are paler than in *orbiceps*.

Male. Length 5–6 mm.

Head, including the eyes, as long as broad, narrowed in the region of the cheeks, which are longer than the eyes and somewhat concave. Mandibles larger, with two teeth, one apical, the other near the middle of the blade. Antennal scapes long and slender, first funicular joint enlarged distally, about three times as long as broad; remaining joints narrower, subequal and cylindrical. Thorax robust, broader than the head, shaped somewhat like that of the female. Petiole like that of the worker, but more acute above in profile. Genitalia resembling those of *Prenolepis*. Legs very slender, with large claws and pulvilli. Wings large, with well-developed discoidal cell.

Body shining, finely and irregularly punctate. Mandibles subopaque, not striated.

Hairs and pubescence similar to those of the worker, but the hairs more tapering and flexuous, and the pubescence more dilute, so that the surface of the body is more exposed.

Black; mandibles, antennæ, tarsi, and joints of legs piceous; bases of genital appendages whitish, tips brownish. Wings hyaline, the membranes somewhat sordid along the costal margin; veins and stigma pale fuscous or sordid yellow.

Colorado: Mt. Washington, near Colorado Springs, July 19 (types); Colorado City; Denver (Wheeler).

Arizona: Grand Cañon (Wheeler).

I should be inclined to regard this form as a mere variety of *orbiceps* were it not that the largest workers and the females are smaller and that no orb-faced individuals occurred in the three colonies which I excavated in Colorado. One of these colonies was very large and contained hundreds of workers and many males and females. The discoidal cell is constant in the wings of ten males in my collection.

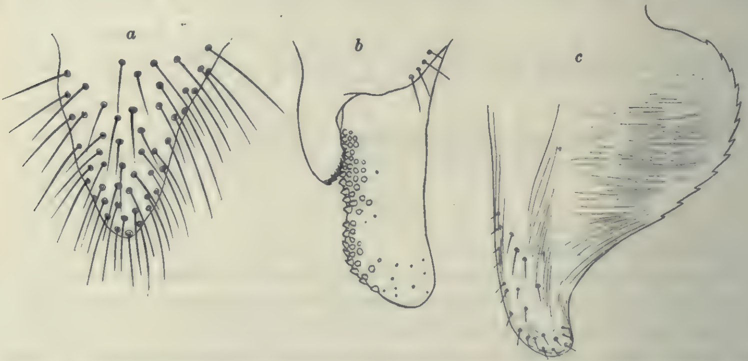


Fig. 4. *Myrmecocystus melliger mendax* subsp. nov., *a*, outer, *b*, median, *c*, inner genital valve of male.

4. **Myrmecocystus melliger mendax** var. **comatus** var. nov. (Fig. 5.)

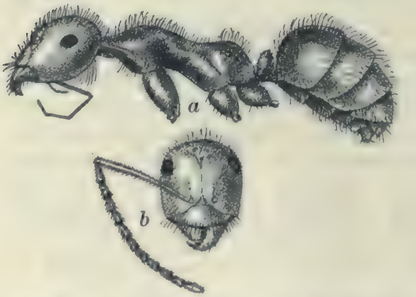


Fig. 5. *Myrmecocystus melliger mendax* var. *comatus* var. nov. *a*, worker major; *b*, head of same from above. × 7.

This variety is closely related to the typical *mendax* but differs in having the erect hairs on the body decidedly longer, more abundant, tapering and flexuous. The coloration of all the phases is precisely like that of *mendax*. The male has a discoidal cell in the wing. Length of worker 3.5–6.5 mm.; female 10 mm.; male 6 mm. Described from numerous workers, one female and one male taken from several large colonies at Ft. Davis, Texas, June 8 and 9, 1902.

5. **Myrmecocystus melliger mimicus** subsp. nov.

Worker major. Length 5–6 mm.

Resembling *mendax* but smaller and with different sculpture, color and pilosity. The gaster is shining, like the head, owing to the pubescence being much shorter and more dilute. Thorax and petiole subopaque. Erect hairs yellowish, similar to those of *mendax* but shorter, somewhat less abundant and on the legs more oblique. Head, thorax, petiole, antennæ and legs uniform deep brownish red; gaster black.

Worker minor. Length 3–4 mm.

Head proportionally longer and narrower than in the worker major. Thorax more or less infuscated, especially behind.

Female. Length 8–9 mm.

Sculpture and pilosity as in the worker. Head red, darker behind than in front. Thorax, petiole and gaster black or very dark reddish brown. Legs red, femora somewhat darker. Wings 10 mm. long, with yellowish veins and stigma; membranes very faintly suffused with yellow along the costal border.

Male. Length 4 mm.

Resembling the male *mendax* but decidedly smaller. Mandibles with only one tooth (the apical). Wings usually without a discoidal cell. The hairs are shorter and much less abundant and the surface of the body is more glabrous than in *mendax*. Wings faintly tinged with yellowish along their costal borders; veins and stigma very pale yellow. Mandibles, antennæ, legs and genitalia brown.

Texas: Chisos Mts. (W. B. Phillips); Alamito; Langtry; Ft. Stockton; Alpine; Del Rio; Monahans, Ward Co. (Wheeler).

New Mexico: Albuquerque, May 7, 1905 (Wheeler); Alamogordo (G. v. Krockow); Embudo and Deming (T. D. A. Cockerell); Las Truches (Miss L. Gerhardt).

Arizona: Tucson; Phoenix; Jerome; Tempe; Yucca; Ash Fork (Wheeler).

California: Goshen Jc. (J. C. Bradley).

The types of this subspecies comprising numerous workers, six males and six females, are from Albuquerque. These males all lack the discoidal cell in the wings and the same is true of a single male from

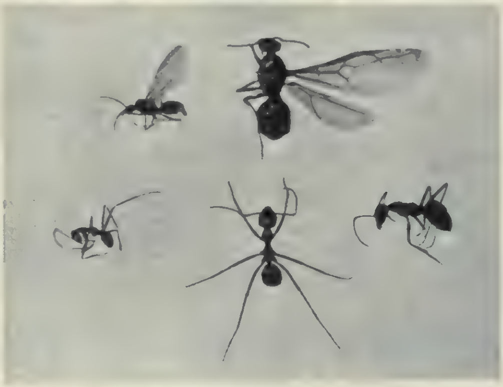


Fig. 6. *Myrmecocystus mexicanus* var. *horti-deorum* McCook. Male, female, major and minor workers, slightly enlarged.

Langtry, Tex. Of six males taken from a single colony at Monahans, Tex., two have a complete discoidal cell, three have no trace of it and in one it is incomplete. The coloration of the workers is somewhat variable, but what I regard as the typical form of the subspecies has the head, thorax, petiole, legs and antennæ of a uniform deep red color and the gaster black and shining and without a silvery gray luster. Such individuals closely resemble certain forms of *Formica*, especially *F. fusca perpilosa* Wheeler and *F. nitidiventris* Emery.

6. **Myrmecocystus melliger mimicus** var. **jesuita** var. nov.

Worker. In size, sculpture and pilosity this form closely resembles the typical *mimicus*, but the thorax and posterior portion of the head are rather inconstant in coloration, varying from very dark red to black.

Ft. Davis, Texas (Wheeler).

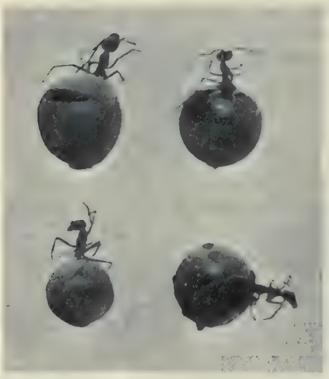


Fig. 7. *Myrmecocystus mexicanus* var. *horti-deorum* McCook. Repletes, slightly enlarged.

The specimens of *mimicus* cited from Alamito and Alpine, Texas, are transitional to this variety as they have the thorax of a very deep red color.

7. **Myrmecocystus melliger mimicus** var. **depilis** *Forel.*

Forel, Ann. Soc. Entom. Belg., XLV, 1901, p. 135 ☿; Wheeler, *ibid.*, p. 205.

Worker minor. Length 4–4.5 mm.

Shining and as dark in color as *jesuita*, but with much fewer erect hairs on the body and appendages. On the scapes the hairs are entirely or almost entirely lacking and are present only on the flexor surfaces of the tibiæ.

Mexico: Pacheco, Zacatecas (Wheeler).

California: Needles, Mojave Desert (Wheeler).

A cotype of this variety from Pacheco, in my possession, has on the antennal scapes a few erect hairs but these are absent in the type described by Forel and in a single specimen from the Needles. The material, however, is insufficient, and the variety may have been based merely on rubbed specimens of what I have called *jesuita*.

8. **Myrmecocystus melliger semirufus** *Emery.*

M. melliger var. *semirufus* Emery, Zool. Jahrb., Abth. f. Syst., VII, 1893, p. 667, ☿ ♂.

Worker. Length 3–4.5 mm.

Differing from the preceding forms of *melliger* in the smaller and more nearly uniform stature of the workers, and in color. Head, thorax, legs and antennæ light yellowish red, petiole brownish, gaster blackish or piceous. Surface of body rather shining. Hairs and pubescence somewhat sparser and shorter than in *mimicus*, gular ammochætæ longer than in any other form of *melliger*. Pubescence most abundant on the gaster to which it gives a grayish tinge and silky luster.

California: San Jacinto (Emery); Needles (Wheeler).
Arizona: Phoenix; Tucson; Yucca (Wheeler).
New Mexico: White Sands (G. v. Krockow).

Emery undoubtedly includes two distinct forms of *melliger* under the name *semirufus*: what I shall regard as the true *semirufus* from California and small workers of *mendax* from Denver, Colorado. He also describes male specimens but does not mention whether these came from California or Colorado. Judging from their size (5–6 mm.) they were probably from the latter state as we should expect both the male and female of *semirufus* to be even smaller than those of *mimicus*. A type specimen from California, received from Prof. Emery, is identical with all the specimens recorded from the above mentioned localities in that state, Arizona and New Mexico. I shall show in the sequel that *semirufus* is a very distinct form ethologically.

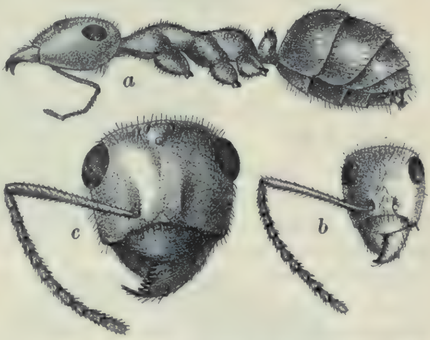


Fig. 8. *Myrmecocystus mexicanus* var. *hortideorum* McCook. *a*, worker, *b*, head of same, *c*, head of female. × 10.

9. **Myrmecocystus melliger semirufus** var. **testaceus** *Emery.*

M. melliger var. *testaceus* Emery, Zool. Jahrb., Abth. f. Syst., VII, 1893, p. 667, ☿.

Worker. Length 3–4.5 mm.

Entirely yellowish red. Sculpture, pilosity and pubescence much as in the typical *semirufus*. The pubescence is longest and densest on the gaster to which it gives a grayish color and silky luster.

California: San Jacinto (Emery); Claremont (C. F. Baker).

Emery attached this variety directly to *melliger* but that it is merely a color form of *semirufus* is shown by specimens taken from several colonies at Phoenix, Arizona and Needles, California. These specimens have the basal half of the gaster yellowish red and the apical half infuscated so that they are intermediate between *semirufus* and *testaceus*. Prof. Emery has kindly sent me a type specimen of the latter form.

10. **Myrmecocystus mexicanus** *Wesmael.*

? *Formica melligera* Llave, Reg. Trim. o Collect. Mem. Hist. Lit., 1832, p. 463; Lucas, Rev. et Mag. Zool., 1860, pp. 269–280. ☿

? *Myrmecocystus melligerus* Roger, Berl. Entom. Zeitschr., VI, 1862, p. 254.

? *Cataglyphis melligera* Mayr, Verh. zool. bot. Ges. Wien, XII, 1862, p. 701, no. 3.

Myrmecocystus mexicanus Wesmael, Bull. Acad. Sc. Belg., V, 1838, pp. 756–761, ☿, figg. 1–4; Westwood, Ann. Mag. Nat. Hist., VII, 1841, p. 145; F. Smith. Cat. Hymen. Brit. Mus., VI, 1858, p. 200, ☿; Trans. Ent. Soc. London (3), I, 1862, Proc. p. 83; Pagenstecher, Jahrb. f. Litt. Heidelb., LIV, 1, 1861, pp. 172–176; Froriep Notiz., II, 1861, pp. 193–197; Weinland, Zool. Garten, II, 1861, p. 135; Riley, Trans. Acad. Sci. St. Louis, III, Journ. of Proc. 1873, p. cix; Emery, Zool. Jahrb., Abth. f. Syst., VII, 1893, p. 666; Forel, Biol. Centr. Amer., Hymenopt., III, 1899–1900, p. 129; Pergande, Proc. Calif. Acad. Sci. (2), IV, 1893, p. 30.

Worker. Length 4.5–9 mm.

Differences between the major and minor workers much less marked than in *melliger*. Head, without the mandibles, distinctly longer than broad in the worker major and even longer in the smaller workers, narrower in front than behind, with rounded posterior corners; sides slightly convex in larger, straight in smaller individuals. Eyes large, more than ¼ as long as the side of the head, placed further laterally and towards the posterior corners of the head than in *melliger*. Ocelli small. Clypeus very faintly carinate in front, its anterior border rounded and slightly projecting. Mandibles 9-toothed, their tips shorter and less curved than in *melliger*. Last joint of maxillary palpi a little shorter than the penultimate joint. Antennæ long and slender. Thorax long and narrow, constricted in the mesoëpinotal region and in this region faintly concave in profile; pronotum low, faintly convex; epinotum more abruptly rounded, its base passing through a very rounded angle into the declivity; seen from above the epinotum is truncated behind, and as broad as long. Petiole less than half as broad as the epinotum, less thickened than in *melliger*, cuneate in profile, with flat anterior and posterior surfaces, with its blunt border faintly impressed in the middle. Gaster narrower, more convex above and more pointed behind than in *melliger*. Legs very long and slender.

Surface shining, very finely punctate-reticulate, but fainter than in *melliger*; mandibles finely and densely striatopunctate. Hairs and pubescence yellowish, shorter and less abundant than in the typical *melliger*, so that they do not conceal the shining surface. Erect hairs on legs and antennal scapes abundant, but little shorter than those on the body, rather obtuse. Pubescence more uniformly distributed and not much denser on the gaster than on the head.

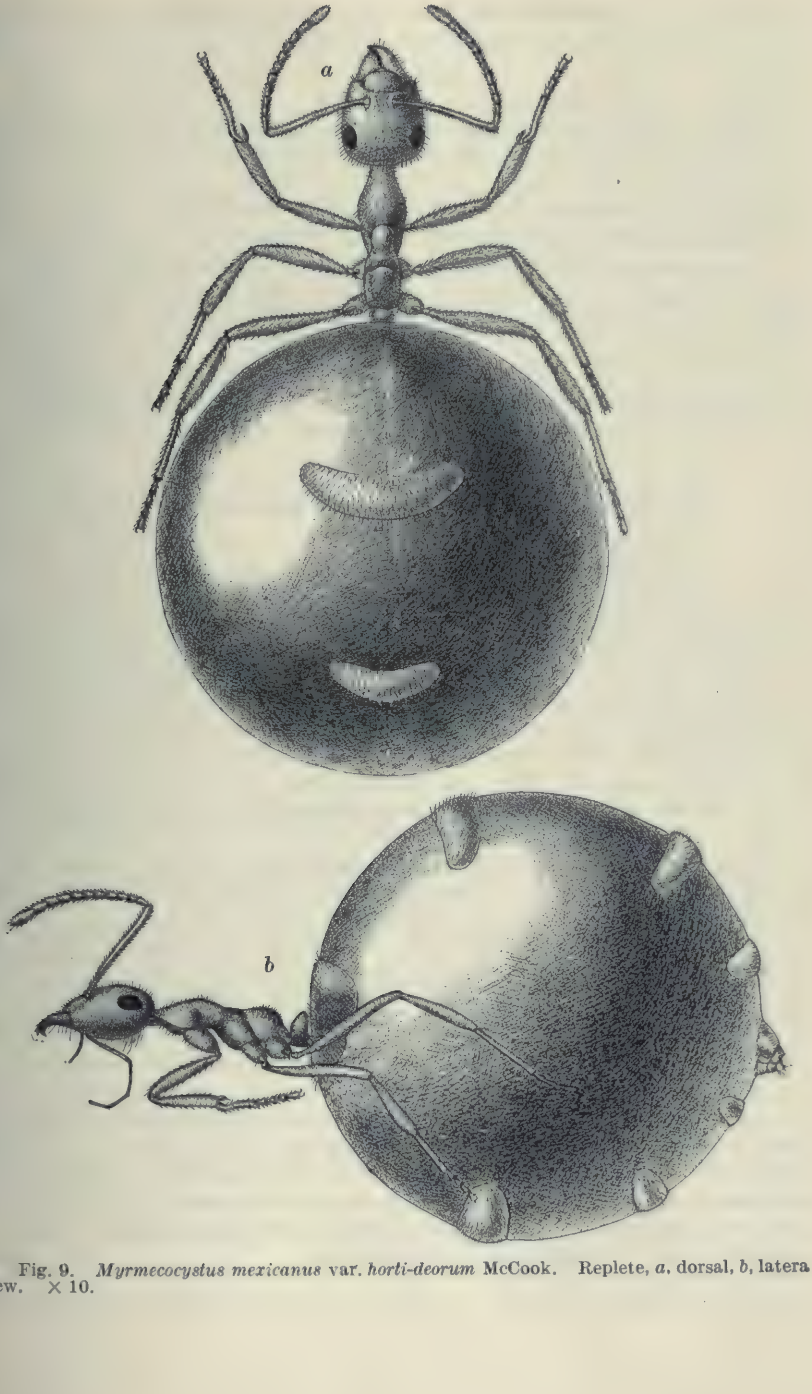


Fig. 9. *Myrmecocystus mexicanus* var. *horti-deorum* McCook. Replete, *a*, dorsal, *b*, latera view. × 10.

Testaceous or yellowish brown; posterior portion of head and upper portions of pro- and epinotum more or less infuscated; gaster fuscous. Teeth of mandibles blackish.

Replete. Length 10–13 mm.

Like the worker in all respects except that the gaster is distended to form a dull amber-colored sphere about the size of a pea.

Mexico: (Wesmael); San Luis Potosi, May 20, 1879 (E. Palmer); Santa Maria, Baja California (Eisen and Haines).

The description is drawn from a series of specimens from San Luis Potosi received from the Museum of Comparative Zoölogy. As these have been in alcohol nearly 30 years, their colors are not very well preserved, but the gaster is distinctly fuscous and the head and upper portions of the thorax are much darker than in the following variety and subspecies. I do not hesitate therefore to refer the specimens to the typical *mexicanus.*

11. **Myrmecocystus mexicanus** var. **horti-deorum** *McCook.*

(Figs. 6–10.)

Myrmecocystus mexicanus H. Edwards, Amer. Natur., VII, 1873, pp. 722–726; Proc. Calif. Acad. Sci. V, 1875, pp. 72–75; Blake, *ibid.*, p. 98; Loew, Amer. Natur., VIII, 1874, pp. 365–366, ☿; Saunders, Canad. Entom., VII, 1875, pp. 12–14, 1 fig.; McCook, Proc. Phila. Acad. Nat. Sci. 1879, pp. 197–198; Ann. Mag. Nat. Hist. (5), IV, 1879, p. 474; Trans. Amer. Ent. Soc., VII, 1879, Proc. p. xxii.

M. melliger Forel, Aerzt. Intelligenzbl. München, XXVII, 1880, p. 32; McCook, Amer. Entomol., III, 1880, pp. 273–274; Proc. Phila. Acad. Nat. Sci., 1881, pp. 170–230, pll. I–X; The Honey Ants of the Garden of the Gods, Phila., 1882, pp. 1–76, pll. I–X; Romanes, Nature, XXV, 1882, pp. 405–406; Karsch, Entomol. Nachr., VIII, 1882, pp. 186–191; Hagen, Stettin. Entom. Zeitg., XLII, 1882, pp. 347–352; Emery, Kosmos, XI, 1882, pp. 296–298; Forel, Mitth. schweiz. Entom. Gesell., VII, 1, 1884, p. 4.

M. melliger var. *hortus-deorum* McCook, Proc. Phila. Acad. Nat. Sci., 1881, p. 75.

M. hortus-deorum Forel, Ann. Soc. Ent. Belg., XXX, 1886, p. 202, ☿ ♀ ♂.

M. horti-deorum Dalle Torre, Catalog. Hymen., VII, 1893, p. 217.

M. mexicanus var. *horti-deorum* Emery, Zool. Jahrb., Abth. f. Syst., VII, 1893, p. 666.

Worker. Length 4.5–9 mm.

Differing from the typical Mexican form in color, which is yellow throughout, with the mandibles and posterior portion of the head slightly reddish. Mandibular teeth dark red. Basal surface of epinotum somewhat flatter than in *mexicanus*; the angle between the base and declivity less rounded and the anterior and posterior surfaces of the petiole somewhat more convex. Hairs and pubescence pale yellow or whitish, the former more slender and tapering.

Replete. Length 10–13 mm.

Like the larger workers except in having the gaster distended and filled with honey.

Female. Length 10–11 mm.

Head similar to that of the worker but as broad as long, without the mandibles. Apical tooth of mandibles very long and curved. Last joint of maxillary palpi little more than half as long as the penultimate joint, which like the third and fourth joints is broad and flat. Thorax like that of the *melliger* forms, broader than the head. Petiole in profile high, with flat anterior and posterior surfaces and rather acute border, notched in the middle. Gaster short, broadly elliptical, convex above. Legs moderately long. Wings long (12 mm.) with large discoidal cell.

Sculpture, pilosity and pubescence as in the worker. The yellow of the head, thorax and gaster is more brownish. Wings hyaline, with yellowish brown veins and stigma.

Male. Length 4.5–5.5 mm.

Very similar to the males of the *melliger* forms, but the mandibles have 2–3 minute and unequal teeth in addition to the apical tooth. The discoidal cell is absent in the wing (I find it present and of abnormal triangular form in only one out of 25 specimens taken from several different colonies), and the genitalia have a different shape (Fig. 10).

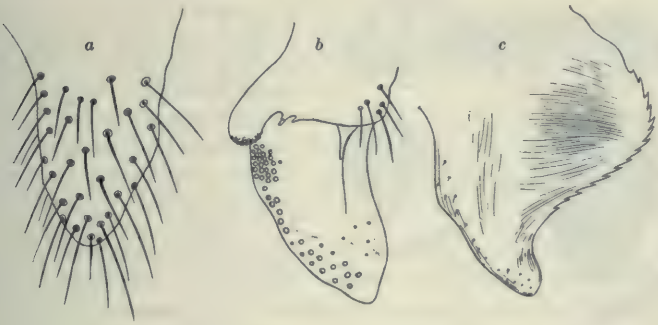


Fig. 10. *Myrmecocystus mexicanus* var. *horti-deorum*; *a*, outer, *b*, median, *c*, inner genital valve of male.

Gaster shining, head and thorax more opaque, very finely punctate or shagreened.

Pilosity and pubescence similar to those of the worker but much less abundant, especially on the legs.

Pale yellow; head and gaster dark brown, thorax lighter brown, its sutures, the genitalia, mandibles, border of clypeus and antennæ whitish yellow; legs and the veins and stigma of the wings sordid yellow.

Colorado: Garden of the Gods, Manitou, Colorado City (McCook, P. J. Schmitt, Wheeler).

New Mexico: Santa Fe (Loew; Krummeck; R. Thaxter, Wheeler Exped.); Abiquiu (Cope); Pecos (T. D. A. Cockerell).

California (McCook).

Redescribed from a number of workers and females from all of these localities except California, and from topotypes of males and females taken July 25–28, 1903 and 1906. This variety is very constant and might be regarded as a subspecies, but before elevating it to this rank, it would be desirable to have more material of the typical form from several localities in Mexico.

12. **Myrmecocystus mexicanus navajo** subsp. nov.

(Fig. 11.)

Worker. Length 3–4.5 mm.

Differing from the two preceding forms in its much smaller size and in the following characters: the whole body is of a pale whitish yellow color, except the gaster which is more or less fuscous owing to the dark contents of the crop showing through the diaphanous yellow integument. The eyes are decidedly larger, being more than $\frac{1}{3}$ as long as the side of the head. The declivity of the epinotum is longer than the base and slightly concave, the petiole is narrow, anteroposteriorly compressed, and its free border is rounded and entire. The hairs and pubescence are much sparser than in the other forms of the species. The scapes have erect hairs only on their anterior surfaces and the legs only on the flexor surfaces of the femora. In some specimens there are also a few oblique hairs on the flexor surfaces of the tibiæ. The surface of the body is uniformly shining and the pubescence is very dilute.

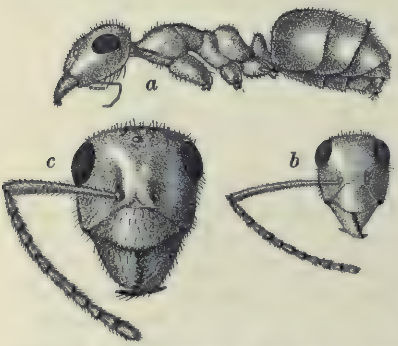


Fig. 11. *Myrmecocystus mexicanus navajo* subsp. nov., *a*, worker; *b*, head of same; *c*, head of female. × 10.

Female (deälated). Length 9 mm.

Head narrower than in *horti-deorum,* with slightly larger eyes. Yellow color of body paler, pilosity and pubescence sparser.

This form, which is very distinct both in structure and habits is described from a large number of workers and a single female taken May 7 and 25, 1905, from several colonies in the dry deserts east of the town of Albuquerque, New Mexico.

13. **Myrmecocystus mexicanus mojave** subsp. nov.

Worker. Length 4.5–5 mm.

Resembling the worker of *navajo* in stature, in the shape of the head and size of the eyes, but differing from this and the other forms of *mexicanus* in having the neck much shorter, so that the pronotum, seen from above, is as broad as long. Hairs and pubescence white, more abundant than in *horti-deorum* and *mexicanus.* Color pale sordid yellow, with the posterior portion of the head brown and the legs and antennæ whitish.

California: Ontario (J. C. Bradley).

Described from two dozen specimens, some of which are in a partially replete condition, with the ingluvies full of honey dew.

PART II. ETHOLOGICAL NOTES AND DESCRIPTIONS.

1. **The Typical Mexican Forms of Myrmecocystus.**

The early accounts of the habits of *Myrmecocystus* in the papers of Llave, Wesmael and Lucas are based on hearsay, as none of these authors saw living specimens. That these accounts refer, perhaps, to two different species is of no great moment, since they are couched in very general terms.

In addition to some notes on a few alcoholic specimens, Llave gives the following description of the habits of his *Formica melligera*: "A careful observer, who lives in the town of Dolores, in the vicinity of which the formicaries are found, told me that, out of curiosity, he had excavated some of the nests belonging to the ants which the peasants call *busileras.* He assured me that the inhabitants of these nests are a species of small ant which does not make an earthen mound at the entrance of its dwelling, and that in following the excavations and removing the earth, one comes upon a kind of gallery from the ceiling of which the busileras hang suspended and huddled together, covering both the roof and the walls of the gallery. He told me also that the peasant women and children are well acquainted with these nests, that they seek them assiduously for the purpose of obtaining the honey and that when they are going to make a present of them, they take hold of them very cautiously, carefully remove the head and thorax and then place them in a dish; but if the insects are to be eaten as soon as found, the saccharine portion is sucked out and the remainder thrown away. The head and thorax are removed, I was told, to prevent the ants from injuring one another, for although they are unable to walk, owing to the prodigious volume of the abdomen, they nevertheless struggle when placed in a dish, and catch hold of and rupture one another, so that in the end they become flaccid and depleted. Indeed, the skin which unites the segments of the abdomen is so delicate and especially so distended, on account of the enormous quantity of honey which it contains, that the least puncture causes the contents to flow out. They say that when this operation, namely the removal of the head and thorax, is not performed, the honey diminishes and, according to the peasants, is consumed by the ants."[1]

Concerning the function of the replete worker Wesmael promulgated an erroneous conception which he gleaned from the statements of Baron de Normann, who brought the types of *M. mexicanus* to Belgium. He says: "According to the statement of M. de Normann, this species of ant constructs subterranean habitations, which the individuals with vesiculate abdomens never leave. There, condemned to almost complete immobility, their unique function is to elaborate a kind of honey, which is then disgorged into special reservoirs analogous to the waxen cells of bees. Unfortunately M. de Normann saw only a fragment of this kind of comb, too distorted to give an accurate idea of its structure, and he could not bring it to Europe, as he knew not how to preserve it during the voyage. For my part, I am much inclined to believe in the reality of the facts reported by our honorable envoy; first, because I have no reason to doubt his veracity; and second, because these facts follow almost of necessity from the structure of these singular ants; for how can we impute the active habits of their congeners to individuals all of whose movements must be impeded by the volume and weight of their abdomen, which, moreover, would have its delicate walls torn by contact with the slightest projection? On the other hand, since these ants, in their capacity as workers, have the ovaries completely suppressed, the volume of the abdomen can be attributed only to an excessive development of the digestive organs it contains, a development which must originate in the superabundance of nourishment brought to these sedentary ants by the other workers; and these workers in turn, would not waste their time and efforts in furnishing their big-bellied companions with such a copious amount of food, if the latter did not return it to the community with interest. Hence the big-bellied ants are only the cooks, so to speak, who prepare food and provisions without other utensils than their stomach.

"One is much inclined to ask, whether in the colonies of the Mexican ants, the big-bellied individuals are already such on quitting the pupal stage. In the absence of positive information on this point, we may suppose that the excessive development of the abdomen is, perhaps, merely the result of over-feeding, coupled with perpetual inactivity. It is well known that in our own species certain individuals who have reached an age when the sexual organs lose their activity, sometimes take on, in the midst of repose and abundance, an enormous abdominal amplitude. It is also

---

[1] I have here translated Lucas's translation of Llave, as I have been unable to find the original even in the beautiful library of the new Hispanic Museum.

known that the same causes produce the same effects in the domestic animals, which we fatten after they have been castrated. Be this as it may, however, it is worth remarking, that in the ants under consideration, the vesiculate abdomen contains no organs; or rather, it is itself only a huge sac-shaped stomach, beginning at the second segment and terminating in the anus."

In May, 1852, Langstroth presented to the Philadelphia Academy some repletes of a *Myrmecocystus* which his brother had collected at Matamoras, Mexico. The low altitude of the locality shows that they belonged to *M. melliger*. These repletes were correctly described "as living repositories for the surplus honey of the colony, which in time of need answer the purpose of the full honey-combs of the bee." At the same meeting Leidy reported on the gastric anatomy of the specimens, asserting that the honey is contained within the greatly distended stomach and that "all the other viscera of the abdomen are completely obliterated, and even the tracheal vessels have entirely disappeared, which is an important physiological fact, as by the supply of oxygen being cut off, none of the honey is consumed in the

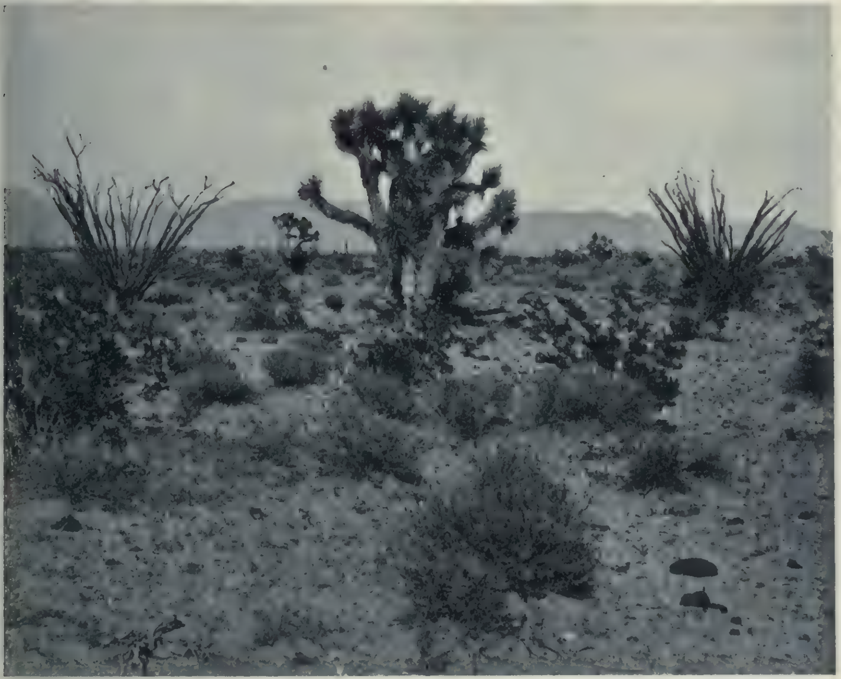


Fig. 12. Desert at Yucca, Arizona; home of *Myrmecocystus melliger mimicus* subsp. nov.

process of respiration." In June of the same year Wetherell (1852) presented to the Academy the results of a chemical analysis of the honey of the Langstroth repletes. He found that the average weight of the honey in one of these individuals was 0.3942 gr., the average weight of the ant 0.048 gr., so that "the honey which an average one of these ants contains is 8.2 times greater than the weight of its body. .... The syrup extracted from the ant had an agreeable sweet taste, the odor very much resembling that of the syrup of squills. It reacted slightly acid to blue litmus paper. When evaporated by the heat of steam, it dried to a gummy mass, which did not exhibit traces of crystallization after standing for a couple of weeks. It was very hygroscopic, becoming quickly soft from the absorption of water from the atmosphere." As a result of further analysis Wetherill found that "the honey contained in the Mexican ant is a nearly pure solution of the sugar, so-called, of fruits, which is in a state of hydration, isomeric with grape sugar, $C_{12} H_{14} O_{14}$ and differing from grape sugar in not crystallizing." The source of the acidity he could not determine, but raised the question as to whether it was formic acid or acetic from the oxidation of the alcohol in which the specimens had been preserved.

These remarks and the meager descriptions of the original specimens of *M. mexicanus* and perhaps also of *melliger,* comprise all the observations that seem to have been published on the typical Mexican forms of the genus. The following observations relate exclusively to the forms occurring in the United States.

2. **Myrmecocystus melliger orbiceps** subsp. nov.

This beautiful form differs from all our other *Myrmecocysti* in the glittering white sheen of its body. In this respect it is not unlike the Saharan *M. bombycinus,* which, when running rapidly over the desert soil, is said to resemble a rolling drop of quicksilver. *M. orbiceps,* too, prefers very hot, dry localities. I have found it along the limestone escarpment which stretches from Austin to Del Rio and forms the Edwards Plateau of Texas, and in the deserts of Trans Pecos Texas, New Mexico and Arizona. It may be most conveniently studied on the Jollyville Plateau, a few miles west of Austin, and at San Pedro Springs on the outskirts of San Antonio. Like the Sarahan *Myrmecocysti* it runs over the ground with great agility in the full glare of the sun.

The nest, which is always in stony soil, has the form of an obscure crater, with an irregular or arcuate and sometimes very large entrance (2–3.5 cm. in diameter) leading down obliquely into the soil. The main gallery thus formed breaks up at a depth of 20–30 cm. into short passages and flat, irregular chambers. The colonies are rather small, comprising hardly more than 300–500 individuals, and therefore resemble colonies of certain species of *Formica* (*subpolita, munda, schaufussi*). Among the workers one always finds a few, sometimes less than a dozen, of the large, orb-headed individuals (Fig. 3) which characterize this subspecies. All the workers contain an abundance of formic acid, with which they seem to defend themselves in much the same manner as the species of *Formica*. A few of them, confined in a vial, are soon suffocated with their own secretions. Winged females were taken April 21 and 27.

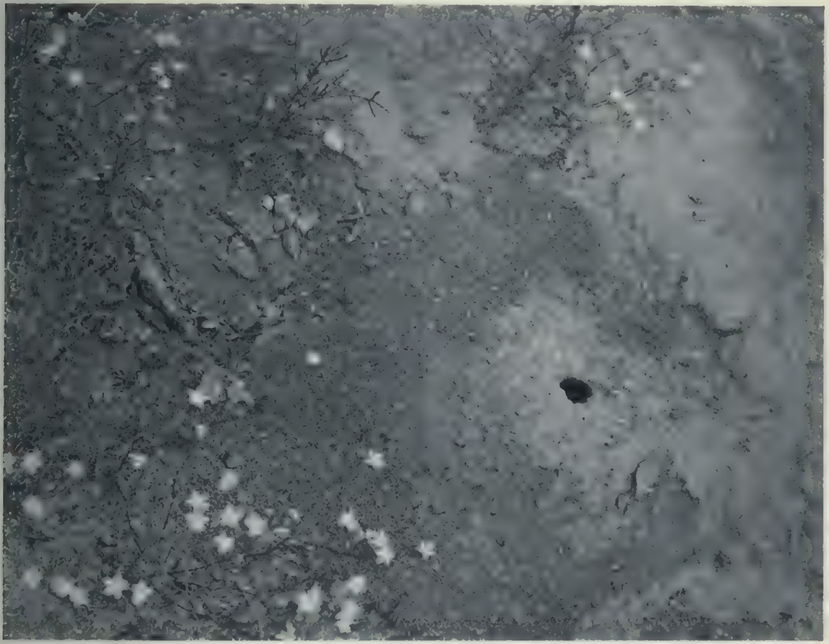


Fig. 13. Nest crater of *Myrmecocystus melliger mimicus* subsp. nov. in adobe soil. Tucson, Arizona. About ½ natural size.

On first examining the colonies of *orbiceps* on the lime-stone hills near Austin, I was greatly impressed with the complete absence of anything resembling the repletes of the typical *melliger*. Again and again, at various seasons of the year and in different localities, I excavated nests, but was never able to observe the slightest tendency to gastric distension in any individuals of the colony. The ants were never seen climbing about on the low desert vegetation in search of aphid excrement or the sweet secretions of galls or flowers. It was not difficult, however, to ascertain the character of their food. On one occasion, while watching a nest, I saw many of the workers returning with male and female termites that had been captured just after their nuptial flight. Others were bringing in dead harvesting ants (*Pogonomyrmex*). In some of the nests whole chambers were set aside as kitchen middens and were filled with the remains of a great variety of insects. I am convinced, therefore, that *M. orbiceps* is a highly predaceous and carnivorous ant like the various palearctic *Myrmecocysti* described by Forel (1890 a and b, 1895), Lameere (1902) and Escherich (1902).

3. **Myrmecocystus melliger mendax** subsp. nov.

This subspecies closely resembles the preceding both in its appearance and in its nesting habits, but has a more northerly distribution. I have seen it only in Colorado. During the summer of 1903 I found a single colony near Colorado City, a second much more flourishing colony near Mount Washington, south of Colorado Springs, and in 1906 a third was found nesting between the cracks of a stone sidewalk in Denver. This is the northernmost point to which any of our *Myrmecocysti* have been traced.

I came upon the Mount Washington colony July 18 at 4.10 P. M. soon after a shower and just as the sun emerged from a bank of clouds. The males and females were issuing for their marriage flight from a nest which was in coarse pebbly soil around the roots of a cactus. I should not have found the colony had not my attention been attracted by the throng of feverish workers surrounding the entrance whence the sexual forms were issuing. There was nothing unusual about the flight: the males and females climbed about on the pebbles and plants with quivering wings and antennæ and rose into the air one by one. As it was late in the afternoon, the nest was marked for excavation on the following day and I walked towards the town. I had gone less than a quarter of a mile when I found several females that had already descended from their flight, removed their wings and were running over the ground in search of a place in which to establish their formicaries. On the following day the nest was excavated with great care in the hope that it might contain repletes, but I was disappointed. Remains of insects in some of the chambers showed that this subspecies, like *orbiceps*, is carnivorous. The nest still contained several males and deälated females which had either returned voluntarily after the marriage flight on the previous day or had not participated in it.

The var. *comatus*, which is merely a more hairy form of *mendax*, was observed only in Hospital Cañon at Fort Davis, Texas. Some of the nests were near oak trees (*Quercus cinerea*), which the ants were ascending, apparently for the purpose of visiting aphids on the foliage, but none of the returning individuals had their gasters enlarged and I was unable to find repletes in any of the nests. Some of the nests, however, had large kitchen middens of insect fragments near their entrances, showing that this ant is predatory like *orbiceps* and the typical *mendax.* The absence of repletes in this instance did not surprise me because some nine months of rainless weather had preceded my visit to Fort Davis, a period more than sufficient to exhaust any store of honey that might have been collected during the previous year.

4. **Myrmecocystus melliger mimicus** subsp. nov.

This is the most abundant and widely distributed form of the genus from Trans Pecos Texas to the Mojave Desert and probably throughout Chihuahua and Sonora. It prefers the pebbly or pure adobe soil of the more arid deserts (Fig. 12). Here it constructs rather regular craters 10–15 cm. across at the base and 3–4 cm. high, with a circular opening varying from 1.5–2 cm. in diameter (Fig. 13). I have carefully excavated a great number of colonies of *mimicus* and its var. *jesuita,* in widely separated localities but have never been able to observe in the workers the slightest

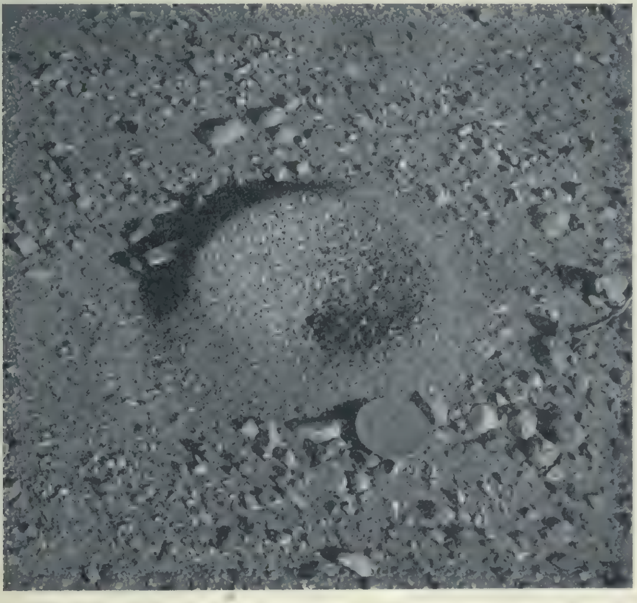


Fig. 14. Nest crater of *Myrmecocystus melliger semirufus* Emery. Needles, California. About ½ natural size.

tendency to develop repletes. The ants live in such arid and barren places that it is difficult to understand how they can obtain sufficient moisture for their daily needs, to say nothing of storing it up for future consumption. The workers are diurnal like those of the preceding subspecies and varieties and prey upon insects.

5. **Myrmecocystus melliger semirufus** *Emery.*

This is a very distinct form characterized by the small size and feeble polymorphism of its workers, and occurs only in the pure sand of the river-bottoms and gullies in the deserts. It is not uncommon along the Gila River near Phoenix, Arizona and the Colorado River near Needles, California. Its craters (Figs. 14 and 15) are somewhat larger and more regular than those constructed by *Lasius americanus* in warm, sandy places in the Eastern States. At Needles the workers were found attending peculiar coccids (*Orthezia*) which were feeding on some small desert shrubs. This would point to the existence of repletes in the nest, but although I excavated a number of these, a task that was greatly facilitated by the loose consistency

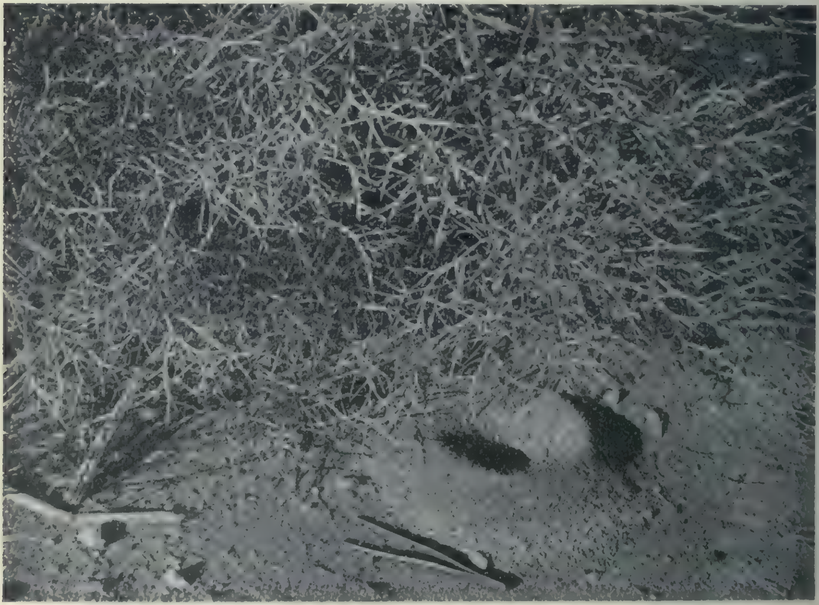


Fig. 15. Nest crater of *Myrmecocystus melliger semirufus* Emery, under all-thorn (*Kœberlinia*) bush. Mojave Desert, California. About ⅛ natural size.

of the sand, I found nothing but workers of the ordinary size and form. At the time I was under the impression that I had succeeded in excavating many of the nests very thoroughly, but as I never unearthed a queen, and as ant-nests in sand are apt to extend far below the surface, I admit that *semirufus* may develop repletes in chambers to which I failed to get access. Nothing is known concerning the habits of the var. *testaceus*, but it, too, probably lives in pure sand.

6. **Myrmecocystus mexicanus** var. **horti-deorum** *McCook.*

The earliest account of this insect was communicated by Capt. W. B. Fleeson of Santa Fe, New Mexico to Henry Edwards (1873). This account, which may be more properly called a fanciful improvisation, impressed Edwards as being so valuable that he communicated it to Charles Darwin and published it both in the 'Proceedings of the California Academy of Sciences' and the 'American Naturalist.' McCook, who a few years later, as we shall see, made a careful study of *horti-deorum*, was inclined to reject the story, but Romanes (1883) republished the whole article, together with the absurd diagram accompanying it, in his book on 'Animal Intelligence,' as a sterling contribution to the study of ant psychology! One may reject lucubrations like those of Capt. Fleeson, Lincecum, Buckley and other exuberant observers of ants, with a few vehement comments, pass them by without remark, or accord them a certain amount of interpretative study. On the whole, I find the last to be the preferable course.

According to Edwards the colonies observed by Capt. Fleeson at Santa Fe "consist of three distinct kinds of ants, probably of two separate genera, whose offices in the general order of the nest would seem to be entirely apart from each other, and who perform the labor allotted to them without the least encroachment upon the duties of their fellows. The larger number of individuals consists of yellow worker ants of two kinds, one of which of a pale golden yellow color, about one third of an inch in length, acts as nurses and feeders of the honey-making kind, who do not quit the interior of the nest, 'their sole purpose being, apparently, to elaborate a kind of honey, which they are said to discharge in the prepared receptacles, and which constitutes the food of the entire population. In these honey-secreting workers the abdomen is distended into a large, globose, bladder-like form, about the size of a pea.'" The third variety of ant is much larger, black in color, and with very formidable mandibles. For the purpose of better understanding the doings of this strange community, we will designate them as follows:

No. 1.— Yellow workers; nurses and feeders.
No. 2.— Yellow workers; honey makers.
No. 3.— Black workers; guards and purveyors."

Then follows a description of the nest and the behavior of the guards which perform certain ridiculous military tactics on three sides of a square. One section of the black warriors is described as "entering the quadrangle by a diagonal line bearing N E, and carrying in their mouths flowers and fragments of aromatic leaves which they deposit in the center of the square."

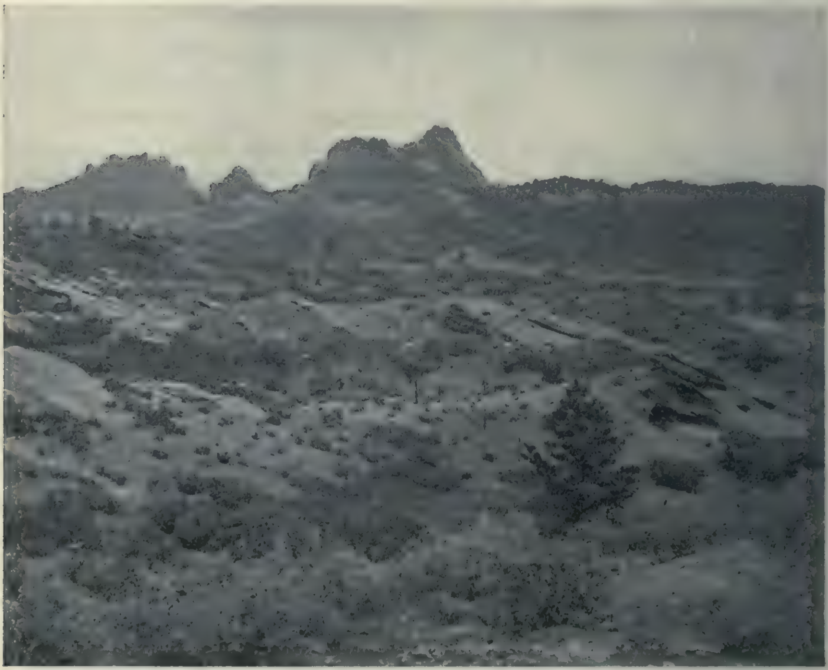


Fig. 16. Garden of the Gods, near Manitou, Colorado, looking north; showing the rocky ridges on which *Myrmecocystus horti-deorum* nests.

The interior of the nest, which has two entrances, is depicted as follows: "By removing the soil to a depth of about three feet, and tracing the course of the galleries from the entrances (b) and (d), a small excavation is reached, across which is spread in the form of a spider's web, a net work of squares spun by the insects, the squares being about one-quarter inch across, and the ends of the web fastened firmly to the earth of the sides of the hollowed space which forms the bottom of the excavation. In each of the squares, supported by the web, sits one of the honey-making workers (No. 2), apparently in the condition of a prisoner, as it does not appear that these creatures ever quit the nest. Indeed it would be difficult for them to do so, as their abdomens are so swollen out by the honey which they contain, as to render locomotion a task of difficulty, if not to make it utterly impossible. The workers, (No. 1), provide them with a constant supply of flowers and pollen which, by a process analogous to that of the bee, they convert into honey."

In 1875 Saunders published a few observations made on *horti-deorum* in the mountains around Santa Fe by Krummeck who says that he has "sat by their nests and watched them working, for, at one time, six or seven hours; the workers carry leaves of different plants home, to feed, as I suppose, the others that produce the honey." Saunders adds that "Mr. Krummeck has tried to procure us specimens of the plants on which this insect feeds, but has not yet succeeded. He does not think that the honey is deposited by these honey ants in cells, as has been stated, but that they keep the fluid in their bodies, and the workers feed from them, and that when the honey in the sac of an individual is exhausted, it dies. In reference to the uses made of this honey in New Mexico, he says that the natives make a very pleasant drink of it, which is made in the proportion of three

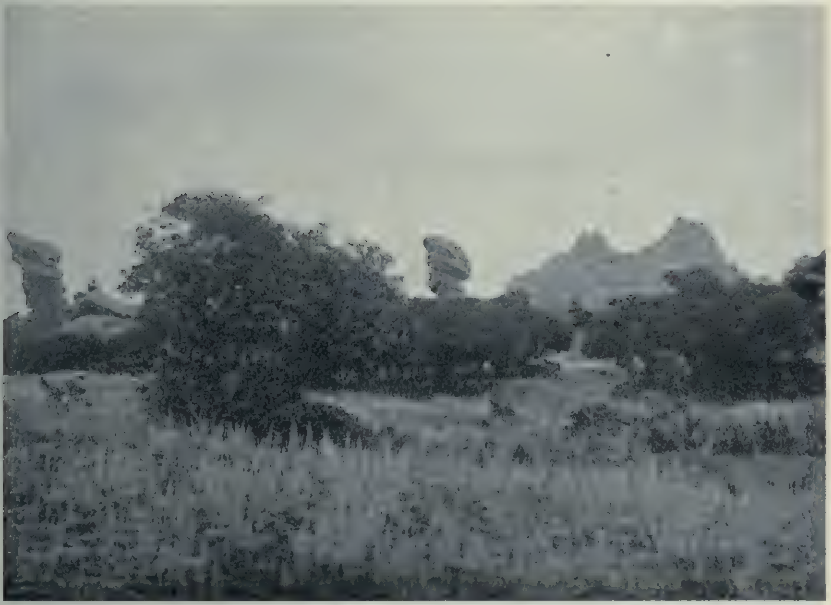


Fig. 17. Shin-oaks (*Quercus undulata*) in the Garden of the Gods.

or four drachms of the honey to six ounces of water. It has not commercial value, is not brought to market, but simply made for their own use. They use this drink among themselves in the mountains in cases of fever, where medical attendance cannot be obtained. The honey is also used by them as a cure for eye diseases, especially for cataract." The following is one of the most interesting remarks in Saunders's paper: "In early life none of these insects present any unusual distension of the body, but when arrived at a certain period of maturity some individuals begin to show a distended abdomen, which after a time becomes swollen into a comparatively immense sphere, produced by the distension of the membrane connecting the abdominal segments, this sphere or sac being filled with a sort of honey. Another class of individuals in the community, raised from the same brood of eggs, manifest no tendency of this sort, but retain the usual normal form of the abdomen." At first sight this looks like a *bonâ fide* observation, but the context shows that it is merely a restatement in somewhat clearer and more positive form of Wesmael's supposition above quoted (p. 362). It occurs, in fact, in a paragraph reviewing the work of the Belgian author. There

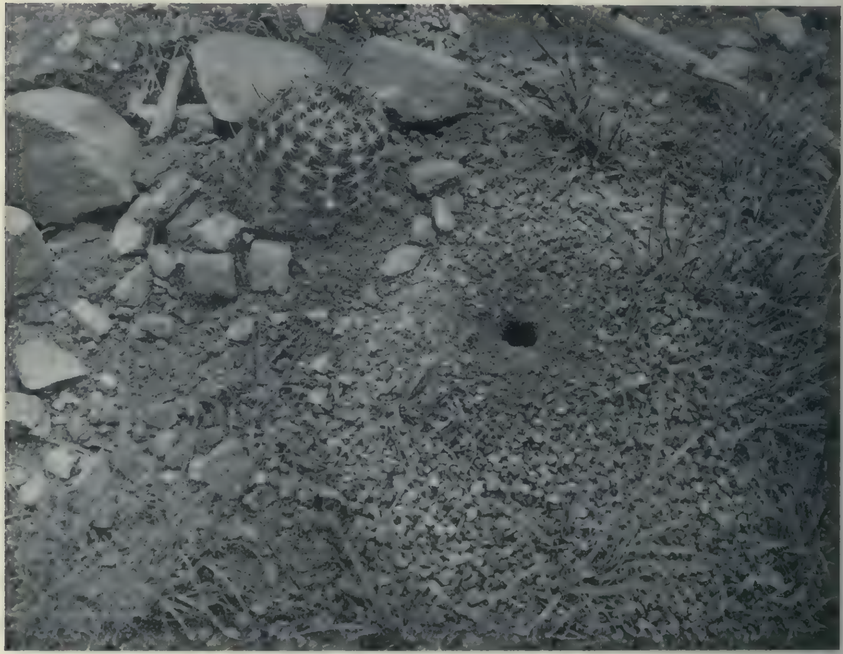


Fig. 18. Nest crater of *Myrmecocystus horti-deorum*, from above; Red Rock Cañon, near Manitou, Colorado. About ⅛ natural size.

is therefore nothing to indicate that Krummeck made any observations of his own on the development of the repletes of *M. horti-deorum.*

We see how Baron de Normann's supposition that the repletes produce honey continued to influence the thoughts of succeeding writers. Capt. Fleeson improvised the gossamer receptacles and both he and Krummeck were of the opinion that the ants used their stomachs as a kind of distillery for making honey out of flowers and leaves. In commenting on Fleeson's vagaries McCook says: "One can hardly refrain from the thought that Capt. Fleeson was testing the credulity of the writer by one of those jokes of which naturalists are occasionally the victims. But, if the narrative is to be taken in good faith, I can only explain the facts by supposing, first, that the observer happened upon a nest of cutting ants (*Atta fervens*), within whose boundaries a nest of *Melliger* had chanced to be established, and had confounded the habits of the two as those of one formicary; or, second, that the cutting-ant, or some other species of similar economy, has really acquired the habit of kidnapping and domesticating the honey ant for the

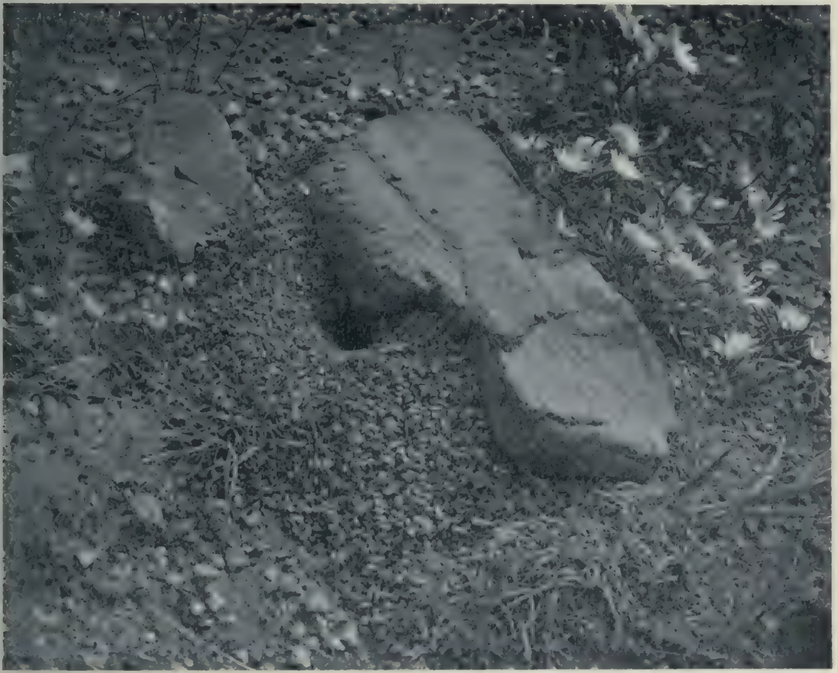


Fig. 19. Nest crater of *Myrmecocystus horti-deorum* built at edge of stone. Red Rock Cañon, Colorado. About ⅙ natural size.

sake of its treasured sweets, precisely as many ants domesticate aphids, or, as the slave-making ants, *Formica sanguinea* and *Polyergus lucidus*, domesticate *Formica fusca* and *F. schaufussi*." I am inclined to believe with McCook, that both Fleeson and Krummeck confounded two totally different species of ants — *M. horti-deorum* and some leaf-cutter, or Attiine ant. The carrying of the flowers and leaves must refer to the latter and the web mentioned by Fleeson would seem to be an attempt to describe the fungus garden of some Attiine ant. But if these suppositions are correct, we must assume that both authors either jumbled together observations which they had made in very different parts of New Mexico, or merely reported from hearsay, for quite apart from the fact that there is no known leaf-cutting ant that agrees with Fleeson's worker No. 3, it may be rather positively stated that there are no leaf-cutting ants in the neighborhood of Santa Fe, which has an elevation of more than 2000 m. We surely cannot suppose that the *Atta fervens* (= *texana*) to which McCook refers, occurs there, because this ant is peculiar to the low-lying and rather humid portions of Texas. I am therefore of the opinion that neither Fleeson's nor Krummeck's accounts contain anything of value except the mere record of the occurrence of *M. horti-deorum* at Santa Fe. Equally worthless is a brief description by Blake (1873) of the gastric structure in some specimens of this ant presented to the California Academy by Edwards, since he confidently asserts that the intestine of the replete "is not continued beyond the thorax," and seems to imagine that the honey is contained in the body cavity!

In 1874 Loew, who was chemist and mineralogist to the Lieutenant Wheeler Exploring Expedition, published a few notes on *M. horti-deorum*, which he, too, observed at Santa Fe. He describes the nest correctly in the main, and then remarks that "the opinion that the honey is discharged into receptacles is entirely erroneous; the only receptacle is their own abdomen swollen up to the size of a pea, clear, transparent," etc. The honey of the repletes is described as "slightly acid in summer from a trace of formic acid, but perfectly neutral in autumn and winter; it contains a little more water than the honey of bees, and has therefore somewhat greater limpidity." Like previous writers he seems to believe that the ants produce the honey in addition to storing it, and makes the utterly impractical suggestion that "it would be worth while for beekeepers to try to introduce them into some kind of bee-hive with a suitable dry soil and the proper food at hand for them."

We owe to McCook (1882) the first and, up to the present time, the only trustworthy and adequate account of the habits of any of the American *Myrmecocysti*. His work is so well known and accessible that I may confine myself to a brief outline of its contents. He discovered *horti-deorum* in the Garden of the Gods near Manitou, Colo. (Fig. 16). The nests, which were found on the tops of stony ridges, are described in great detail. The large circular entrance 2–2.5 cm. in diameter is in the center of a cone-shaped crater of pebbles 8–25 cm. in diameter at the base and 5–8 cm. high (Figs. 18 to 20). The entrance opens into a vertical or oblique gallery which at a depth of 9–15 cm. breaks up into several smaller galleries. These usually extend to one side of the entrance gallery. At a depth of 20–35 cm. the smaller galleries lead into chambers with smooth, flattened floors and rough, vaulted ceilings. These chambers vary from 12–15 cm. in length and 7–10 cm. in width, and may be 4 cm. high in the middle. McCook has described some very large formicaries, the galleries of one of which covered an area of more than 2 sq. m. and reached a depth in the soil of more than a meter. In the chambers the repletes hang, side by side, by means of their claws from the vaulting which is evidently left rough as an adaptation to this peculiar habit (Fig. 21). These individuals are capable of more movement than has usually been supposed, but if they fall from the ceiling they are unable to regain their pendent position without assistance.

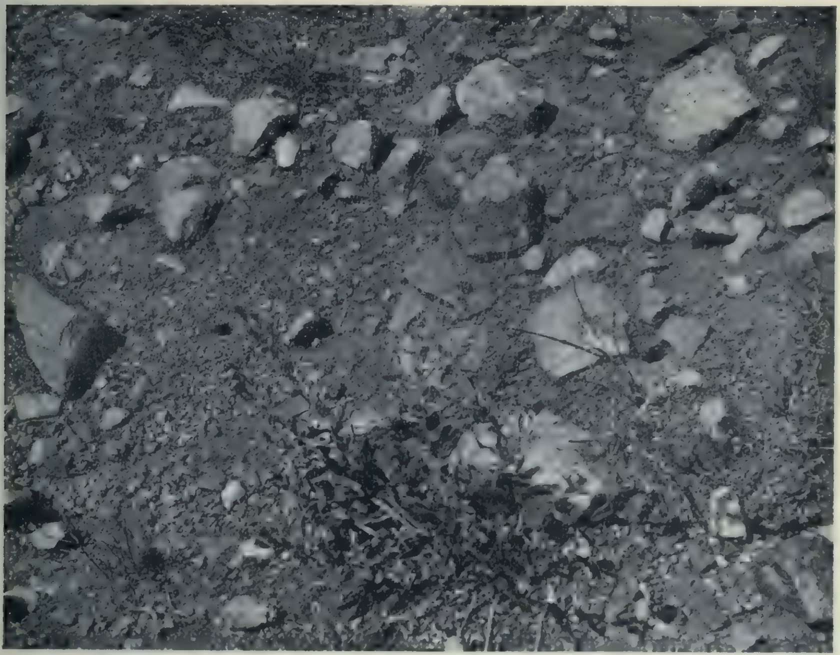


Fig. 20. *Myrmecocystus horti-deorum* nest, with two craters. Red Rock Cañon, Colorado. About ⅛ natural size.

McCook effectively dispels the notion that the repletes manufacture the honey, by showing how they obtain and store it. *M. horti-deorum* is decidedly nocturnal, unlike the different subspecies and varieties of *melliger*, which are diurnal. Indeed, the etiolated appearance and pale yellow color of the northern forms of *mexicanus* at once suggest a fondness for darkness, just as the deeper tints of the typical form of the species suggest diurnal or crepuscular habits. During the day, therefore, the workers of *M. horti-deorum* are never seen outside of the nest, but frequently a guard of workers is stationed just within the large opening, apparently for the purpose of preventing other ants, spiders, etc. from entering the nest. McCook found that during July the workers leave the nest in a file at about 7.30 P. M. and visit the shin oaks (*Quercus undulata*) which grow abundantly along the rocky ridges in the Garden of the Gods and the surrounding country (Fig. 17.) The twigs of these oaks are often covered with small woody galls about the size of a pea and of a more or less conical or spheroidal shape, the work of the Cynipid *Holcaspis perniciosus* Bassett.[1] At night these

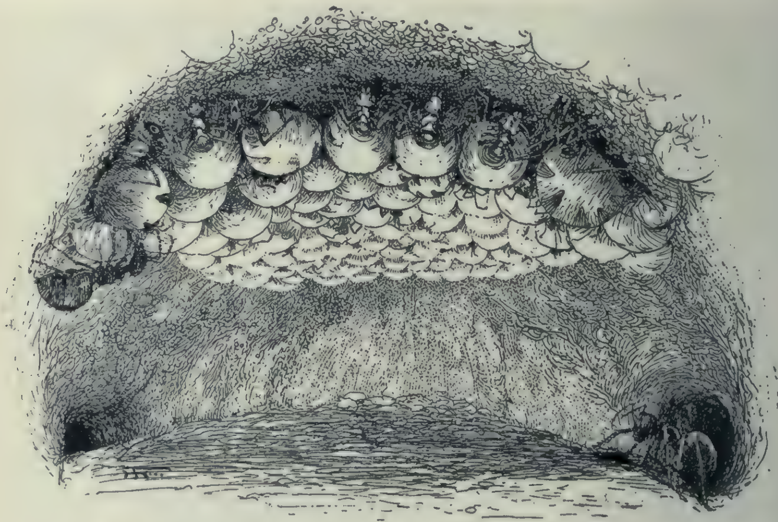


Fig. 21. Repletes of *Myrmecocystus horti-deorum* hanging from roof of honey chamber. (After McCook.)

---

[1] Riley in 1880 briefly described these galls under the name of *Cynips quercus-mellaria*, but he did not breed the insect that produces them. This was described by Bassett in 1890 as *Holcaspis perniciosus* and was taken from galls collected in Utah. I have not seen Bassett's types, but a lot of galls labelled "*H. perniciosus*, Garden of the Gods" in the Bassett collection of the American Museum of Natural History are unquestionably the same as those described and figured by McCook in 1882 as Riley's *C. quercus-mellaria*. I should be inclined to accept this as the specific name of the insect, for there can be no doubt concerning the identity of the galls, were it not that there seems to be a growing unwillingness on the part of cecidologists to recognize names based merely on the plant deformations.

galls exude minute droplets of a sweet, watery secretion (Fig. 23). This is eagerly collected by the ordinary workers, carried to the nest in their crops and fed to the repletes, which thus function as living bottles or casks, storing the precious liquid so that it can be drawn upon when other sources of food are exhausted.

Forel, in 1880, disproved Leidy's and Blake's statements by showing that the gaster of the replete *horti-deorum* owes its size and rotundity exclusively to an enormous distension of the crop, or ingluvies and not of the stomach, and that all the other structures found in the gaster of the ordinary worker are present in the replete, though they are necessarily crowded up against the gastric wall. These observations were confirmed by McCook's careful dissections and figures of the gaster of ordinary workers, semirepletes ("semirotunds") and repletes. He inferred that "the process by which the rotundity of the honey-bearers has probably been produced, has its exact counterpart in the ordinary distension of the crop in overfed ants; that, at least, the condition of the alimentary canal, in all the castes, is the same, differing only in degree, and therefore, the probability is very great that *the honey-bearer is simply a worker with an overgrown abdomen.*" He found, moreover, that "a comparison of the worker with the honey-bearer shows that there is absolutely no difference between them except in the distended condition of the abdomen" and he therefore inferred "that the worker majors, for the most part, and sometimes the minors, are transformed by the gradual distension of the crop, and expansion of the abdomen, into the honey-bearers, and that the latter do not compose a distinct caste.

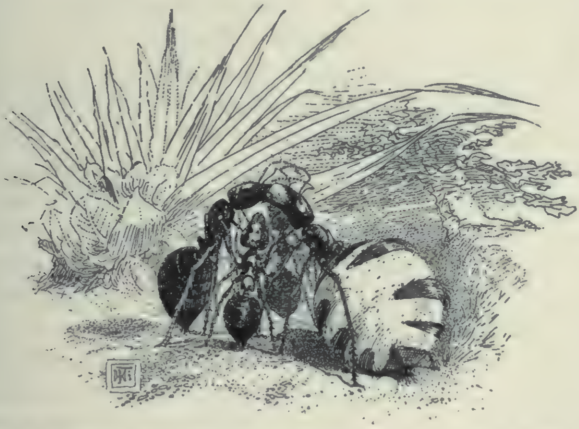


Fig. 22. Replete *Myrmecocystus horti-deorum* in the act of regurgitating food to workers of the ordinary form. (After McCook.)

It is probable, however, that some of the majors have a special tendency to this change by reason of some peculiar structure or form of the intestine and abdominal walls." Although McCook gave these excellent reasons for believing that the replete must develop from a worker of the ordinary type, he did not actually witness the transformation. His account covers a great many other details in the behavior of *M. horti-deorum*, but as many of these are common to most other Camponotine ants, I need not discuss them in this connection.

My own observations on *M. horti-deorum* were made during July and August 1903 and 1906. At first I worked in the Garden of the Gods and located several nests on the ridges where McCook make his observations many years ago. But the region is now so overrun by tourists that careful and continuous observation of ant-nests is out of the question. I therefore sought new localities and was soon able to find a number of fine nests south of the Fontaine-qui-Bouille, along Bear Creek and Red Rock Cañons. A few nests were also found at a much greater distance from the Garden of the Gods, west of Manitou and south of the Ute Pass. In all of these localities there are thickets of shin oaks (*Quercus undulata* and *gambeli*) and the nests are situated only on the summits of dry, stony ridges, just as they are in the Garden of the Gods.

During the two summers I excavated fully a dozen fine colonies of *horti-deorum* and was able to confirm in nearly every detail McCook's interesting account of the nest architecture and the habits of the ordinary and replete workers. I was unable to make observations at night but have no doubt that McCook's account of the foraging habits is perfectly accurate and trustworthy. I am inclined to believe, however, that the exudations of the *Holcaspis* galls may furnish only a portion of the food of the ants and that these insects may obtain much, if not most of their honey from the coccids and aphids on the oaks and other plants in the neighborhood. It would be strange, indeed, if these ants did not take advantage of this food supply which undoubtedly must be greater than that obtainable from the galls.

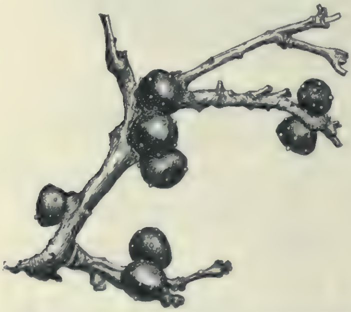


Fig. 23. Galls of *Holcaspis perniciosus* on twigs of *Quercus undulata*, showing the exuding droplets which are collected by the workers of *Myrmecocystus horti-deorum*. About ⅔ natural size.

I have been able to prove what has been surmised by previous observers, namely, that workers of the ordinary size and form develop into repletes. In the nests which I excavated during July there were many workers, males and females. While keeping several colonies in artificial nests it occurred to me that the change from the ordinary to the replete worker must begin during the callow stage while the integument of the gaster is still very soft and distensible. I accordingly isolated a number of young callows in two of my nests and fed them with maple syrup and cane sugar water. They partook of the substances greedily, and a few of the workers in each nest gradually began to assume the replete condition. During the course of four to six weeks several of them became what I call semirepletes (McCook's "semirotunds") and four of them, three in one nest and one in the other, actually attained the dimensions of the perfect replete. Most of the workers, however, showed no inclination to assume this form. In most cases, as McCook has shown, it is the major workers that most readily tend to become repletes, but this is not an invariable rule. In the honey chambers of opulent colonies I have usually found a few replete mediæ and minimæ hanging among the larger but no more turgid sisters. Thoroughly hardened workers of the ordinary form, according to my observations, are no longer able to become repletes. It is probable, therefore, that McCook's failure to secure repletes from isolated major workers was due to his using individuals that were too old.

Why certain callows should aspire to become animated pots or casks, while others prefer to be active foragers and providers, is an enigma. I do not believe, however, that this is due to differences in the "structure or form of the intestine and abdominal walls," as McCook suggests. It is more probably an unusual example of the division of labor, which is shown by careful study to exist in various forms and degrees among all ants with monomorphic workers. The individual worker performs different duties at different stages in its life, beginning in its callow stage as a mere nurse, then becoming a forager, warrior or guard and in its old age sometimes encroaching on the function of the queen by becoming a parthenogenetic mother. It is not improbable that many worker ants acquire habits — using this word, for the moment, in its restricted and technical sense as employed in human psychology — and tend to perform throughout life the special function which they happened to assume while in the callow stage. This may account for the development of the replete both in the individual and the species not only in *M. horti-deorum* but in all other honey ants.

While excavating the nests above mentioned, I was impressed with certain peculiarities in their structure and situation, which seem to be explainable only as adaptations to the development of repletes. One of these peculiarities is the great hardness of the soil that is preferred by the ants. This is the more astonishing because the workers are such slender and delicate organisms. It is evident that hard soil is best suited to the construction of vaulted chambers like those in which the repletes hang, whereas soft or friable soil would be most disadvantageous. The development of repletes also makes it necessary for the ants to seek very dry situations for their nests. Hence we always find them, in the environs of Manitou at least, on the summits of ridges which shed the rain very rapidly. The honey chambers must be kept very dry both to prevent the disastrous results of crumbling and slipping walls and to obviate the growth of moulds on the repletes, which are, of course, imprisoned for life in dark cavities and filled with substances that readily favor the development of fungi. I believe also that the size of the nest openings and galleries, which are so much larger than would seem to be required by such small, slender ants, may be an adaptation to securing plenty of fresh air in the honey chambers. If these suppositions are correct there is obviously a reciprocal relation between the replete habit and an arid environment: the ants store honey because they are living in an arid region where moisture and food are precious and the storing of honey in replete workers, in turn, is possible only in very dry soil.

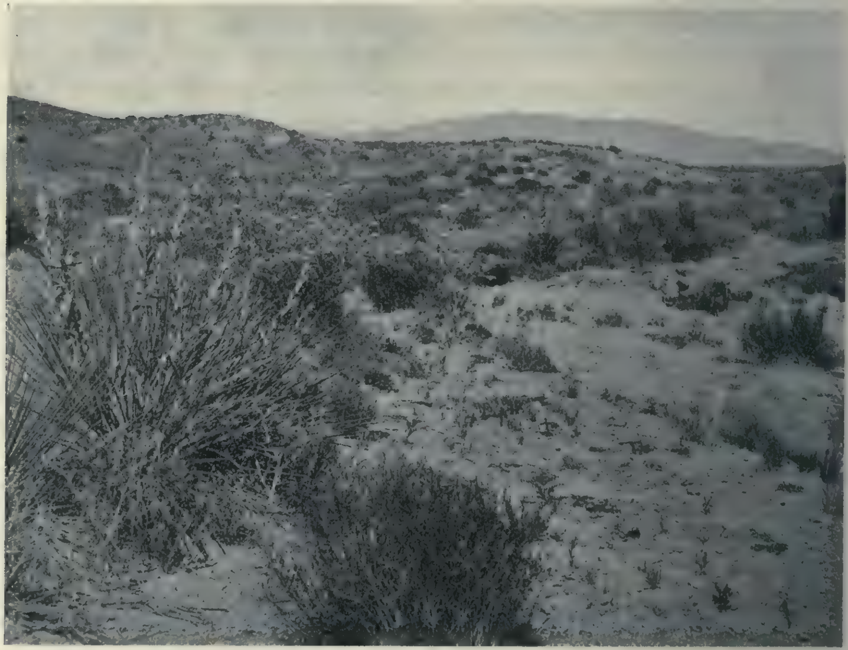


Fig. 24. Desert near Albuquerque, New Mexico; home of *Myrmecocystus mexicanus navajo* subsp. nov.

7. **Myrmecocystus mexicanus navajo** subsp. nov.

This subspecies bears somewhat the same relation to *M. horti-deorum* that *semirufus* does to *melliger*, that is, it is a small, pale, depauperate form. I found its nests to be rather common, though widely scattered, in the desert south of Albuquerque, New Mexico (Fig. 24). A few were seen even in the streets of the town. They are, however, so very inconspicuous that my finding them was the merest accident. The entrance (Fig. 25*a*) is very small, not more than .5–1 cm. in diameter and is not surrounded by a conical crater as in nearly all the other American *Myrmecocysti*. A vestige of this structure may nevertheless be said to be present, for a very thin layer of small pellets of earth is scattered by the ants over a circular area, 30–60 cm. in diameter, around the entrance (Fig. 25*b*). Immediately encircling the entrance, however, there is a zone free from pellets.

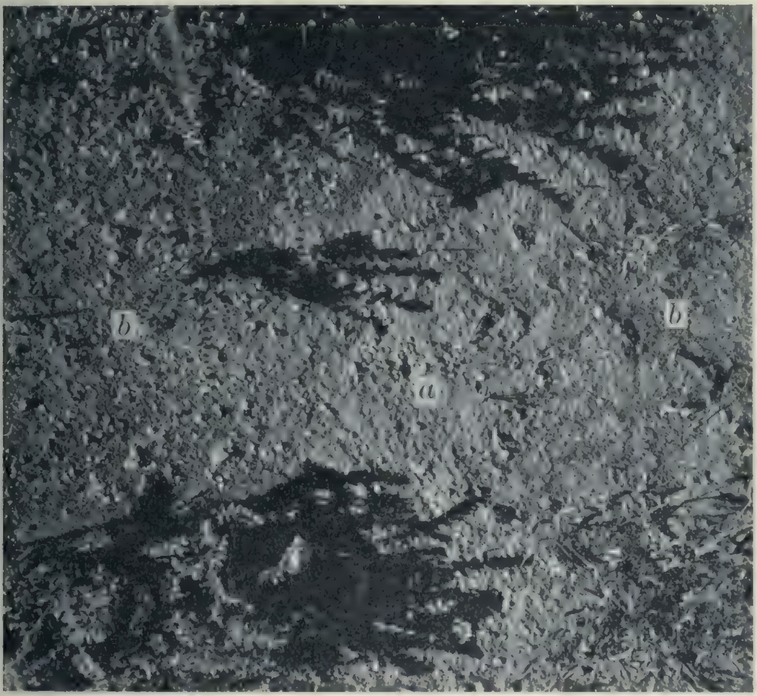


Fig. 25. Nest of *Myrmecocystus mexicanus navajo* subsp. nov. near Albuquerque, New Mexico. Entrance in middle of figure, at *a*; vestiges of crater shown as fine granulations at *b*. About ⅓ natural size.

I excavated twenty-two of these nests and found their internal structure to be like that of the *horti-deorum* nests, except that the galleries are more tenuous and the chambers smaller and less distinct. The latter lie at a depth of 20–25 cm. The colonies, too, are much smaller than those of *horti-deorum* and comprise hardly more than 100–150 workers. No traces of repletes could be found in any of the nests although several of these were so completely excavated that I obtained the mother queen. All the nests contained larvæ and cocoons but no males were taken on the two occasions when I collected at Albuquerque (May 7 and 28).

There can be no doubt that *M. navajo* is a distinctly nocturnal ant. It is even paler and more etiolated than *horti-deorum*. I was unable to learn anything about its feeding habits. The dry mesa on which it lives has an elevation of about 1300 m. and at the time of my second visit was covered with blooming desert plants (*Yucca, Ephedra, Astragalus, Dalea, Fallugia,* etc.). These, in all probability, support aphids, coccids and membracids which in turn furnish *M. navajo* with food, for I can hardly believe that this delicate little ant is carnivorous.

PART III. HONEY ANTS OF VARIOUS GENERA AND THE SIGNIFICATION OF THE REPLETE.

The foregoing account shows that both of the North American species of *Myrmecocystus* are sufficiently plastic to have produced several races and that these differ from one another more in their habits than in their structure. In the same species, *melliger*, as we have seen, there are forms that produce repletes and seem to feed almost exclusively on sweet juices, and other that are highly carnivorous and are not known to have workers with distended crops. We must conclude, therefore, either that the observations represent the permanent condition of the colonies, in other words, that certain races always and others never develop repletes, or that repletion, which is merely a physiological state, is an inconstant character. The latter conclusion implies that only certain colonies, at certain times in their development, or when nesting in certain regions, where the sweet exudations of aphids and plants abound, develop repletes, whereas colonies of the same races nesting in a different environment have become increasingly predatory and carnivorous. After studying these ants and excavating many of their nests at all seasons of the year and in many localities in the southwest I am inclined to believe that the replete habit is confined to certain subspecies and varieties, both in *M. melliger* and *mexicanus*, but am compelled to admit that some or all of these forms may be sufficiently plastic to assume either the replete or the predatory habit according to circumstances. This doubt has prevented me from describing the predatory forms of *M. melliger* as distinct species. I leave the matter to be decided by some future investigator who can devote months or even years to the study of our desert ants.

Although my observations are incomplete, they prove nevertheless that the conditions in the majority of the subspecies and varieties cannot be the same as those described for *M. horti-deorum*. If such deserticolous forms as *M. orbiceps, mendax, mimicus, semirufus* and *navajo* ever produce repletes, the sweet liquid used for this purpose cannot be obtained from oak-galls, for the very simple reason that oaks do not grow in the deserts. And as the low, dry, halophytic and xerophytic vegetation of these regions develops very few galls of any kind, honey would have to be supplied by coccids and aphids, and these, too, are by no means abundant on desert plants.

That repletion, nevertheless, may be merely a sporadic or temporary condition among the different American *Myrmecocysti* seems to be indicated by the manner of its occurrence among other ants. It will therefore be advisable to review the observations that have been made on the replete habit in general, especially as such a review will also show some of the phylogenetic stages through which the typical *M. melliger* and *mexicanus* and the variety *horti-deorum* have, in all probability, passed.

Repletes are known to occur only in the Camponotinæ and Dolichoderinæ, the two subfamilies comprising the ants most given to feeding on the sweet excretions of Homoptera and the exudations of the galls and nectaries of plants. Structurally these ants differ from most of the species of Ponerinæ, Dorylinæ and Myrmicinæ in having a thinner and more pliable chitinous investment over the whole body, and especially over the gaster. When out foraging on the surfaces of plants the individual worker is therefore able to collect and carry home a considerable amount of honey by greatly distending its crop. This leads to a separation of the gastric sclerites and the transparent intersegmental membrane is exposed to view, permitting the light to shine through the limpid contents of the crop, while the remaining abdominal organs are crowded up against the posterior wall. This distension, which may be called incipient repletion, is often seen in the workers of our various species of *Formica, Lasius, Camponotus, Prenolepis, Brachymyrmex*, etc. that are returning to the nest from a visit to their herds of aphids and coccids. Any of the workers of the colony, especially while in their callow or semicallow stages, may assume this incipient repletion, which is very slight compared with the perfect repletion of *Myrmecocystus.*

The relatively insignificant distension of the gaster in the foraging workers of the ants above mentioned is the generalized basis from which the more specialized condition of the true honey ants has arisen, first, by restricting the repletion to certain workers in the colony (physiological division of labor), and second, by exaggerating the distensibility of the ingluvial and gastric walls in these individuals. Certain callows, engaged in feeding the young, had a tendency to remain in the nest and receive the honey brought in by foragers. At first they were simple receivers, able to move about freely through the chambers and galleries of the nest, and distribute the food to the larvæ and their fellow ants, but in the course of time, by increasing their capacity, they became receptacles, without power of locomotion and suspended themselves from the ceiling of the chambers as living flagons of honey with animated necks and stoppers. Those who, in anthropomorphic mood, are wont to extoll the fervid industry and extraordinary muscular performances of ants should not overlook the patience and self sacrifice displayed by the replete *Myrmecocystus* as it hangs from the rafters of its nest, month in, month out, for years perhaps — a reservoir of temperamental as well as liquid sweetness.

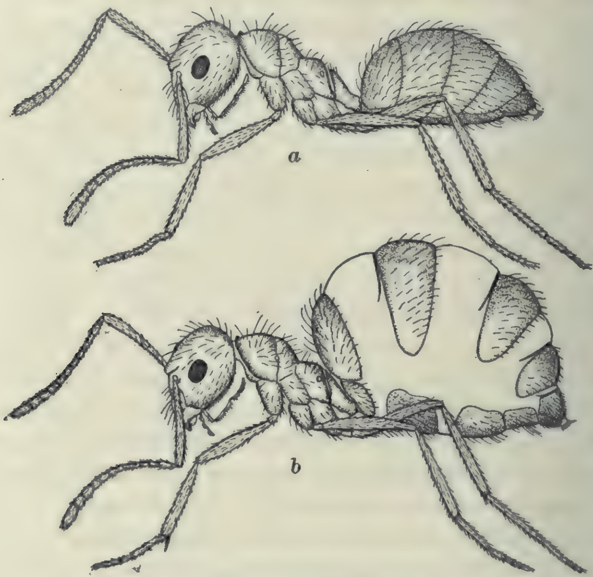


Fig. 26. *Prenolepis (Nylanderia) imparis* Say; *a*, worker in ordinary condition; *b*, replete. × 12.

We may now turn to a consideration of the honey ants described by various authors. The species may be arranged in two series, the first comprising certain forms that exhibit what may be called the semireplete condition — a stage somewhat in advance of incipient repletion, the second the forms that have attained the extreme of gastric distension. To the former belong the five first cases described below, to the latter only *Campo-*

notus inflatus and the *Myrmecocysti.* The transition from the semireplete to the perfect replete is represented by *Plagiolepis trimeni* and *Leptomyrmex rufipes.* In conclusion I have added a few remarks on a small group of Indomalayan *Cremastogaster* species, which have been regarded as honey ants.

1. **Prenolepis (Nylanderia) imparis** (*Say*).

This ant, which is the largest of the North American species of the genus, though it measures only 3–4 mm., is also the most widely distributed, ranging across the continent from the Atlantic to the Pacific in the transition zone. The typical form, which is dark brown or black, prefers to nest in clayey soil in shady places, but the smaller and paler variety *testacea* Emery occurs in pure sand. I have found both forms most abundant in the immediate vicinity of oak-trees, *testacea* in the pine barrens of New Jersey and the typical *imparis* in the rich woods of that state, Illinois and New York. The colonies rarely comprise more than 300 or 400 workers. The nests are never under stones, but always in the form of small craters, consisting of rather large, irregular earth or sand pellets, which at first sight resemble the pellets excavated by the smaller Attiine ants of the subgenus *Trachymyrmex.* *N. imparis* is a very timid, mild-mannered ant and lives very largely on the exudations of plants and the honey dew of aphids and coccids. The workers visit their pastures in files and return with their gasters greatly distended. Fig. 26 shows the difference between a depleted worker (*a*) leaving the nest and one returning with its gaster distended to its utmost capacity (*b*). In the latter the more heavily chitinized, brownish sclerites of the gaster are widely separated by the tense intersegmental membranes, through which shine, like an amber bead, the liquid contents of the crop. The gait of the depleted insect is very free and elegant, but when its crop is full it lumbers or waddles along in a very awkward fashion.

My attention was first called to the repletes of *Nylanderia* by my friend Prof. Harold Heath, who sent me a lot of specimens which he had been observing in California. With these he sent the following notes which I transcribe from his letter of April 15, 1901: "In our yard here in Palo Alto is a remarkably large nest of the *Prenolepis* among the roots of a live oak. This latter habitat is also shared by several colonies within a mile or so of the university, and there are numerous others living under the eucalyptus, cypress and other trees. In similar positions they occur widely through the Santa Clara Valley, especially about San José, where they also tunnel by the road sides and in bridle paths far up on the sides of the foot hills.

"Many of the colonies during the heat of the day remain comparatively quiet, coming out during the morning and evening; but in several of the nests well-shaded, especially by the live-oaks, they are incessantly active throughout the day. In the nest here in the yard a continual incoming stream laden with food stuffs passes the procession going up the trunk and along the branches, and a careful search among the delicate twigs and leaves usually brings to light many individuals actively engaged in collecting food. This appears to be a waxy secretion which accumulates on the undersides of the leaves, on the stems and upon the buds of yet undeveloped leaves. It is certainly not the sap of the tree, for several twigs which I barked were passed over without notice. As many as ten individuals may occasionally be found at work on the underside of a single leaf, working their mandibles actively and gathering up small quantities of something which, as I have said, appears to be a waxy or resinous secretion. This is stored up by several individuals, possibly the majority, for the abdomens of those returning to the nest are as a usual thing somewhat larger than those of the members leaving it and appear more or less translucent. In perhaps one out of twenty the abdomen is twice the normal size, frequently giving such individuals a shaky, uncertain gait. The secretion has a sweet taste, sometimes also slightly acid, something like that of weakly acidulated honey.

"During the ascent of the tree several workers may stop as if resting and group themselves in a shaded fissure of the bark and remain for several minutes or even hours before proceeding on their journey, but so far as I have been able to observe, all of those *en route* for the nest never delay.

"Very frequently individuals are seen returning to the nest with withered oak-flowers or parts of insects. Their diet appears to be varied, as I have noticed in a colony kept in an artificial nest (Janet pattern), raw or cooked meat, insects and almost any substance with a sweetish taste being acceptable."

The late Rev. P. J. Schmitt, O. S. B., wrote me several years ago, that he had long been familiar with the replete habit of *Nylanderia*, and I have also had frequent occasion to see the ants visiting aphids and the extrafloral nectaries of *Ailanthus glandulosa* and other plants and returning to their nests with greatly distended gasters. The "waxy secretion" mentioned by Heath was probably honey dew or some substance analogous to that exuding from the galls of *Quercus undulata* in the Garden of the Gods. Kellogg (1905, p. 547, fig. 750) has recently mentioned the habits of *Nylanderia* and published a figure in which the distension of the gaster in the repletes is unduly exaggerated.

The replete habit is also observable in our North American species of *Prenolepis sensu stricto* (*P. parvula, bruesi, melanderi*) which are all much smaller insects than *Nylanderia* though of similar habit, except that they very frequently nest under stones. In none of these species, however, are the repletes as numerous or as much distended as those of *imparis*. All of our species of *Prenolepis sensu lato* are peculiar in that the males and winged females which mature during late summer or early autumn, pass the winter in the maternal nests and celebrate their nuptial flight early in the following spring. It is probable that this hibernation of the virgin sexual forms is rendered possible, or at any rate facilitated, by the ability of the workers to store up liquid food, although in this respect they are very inferior to *Myrmecocystus*. This ability to store food may also account for the large size of the queens of *Prenolepis*, and especially of *Nylanderia*, as compared with the workers.

Our tiny *Brachymyrmex heeri depilis* Emery has habits very similar to those of certain *Prenolepis*. It lives a subterranean life under stones, cultivating root-coccids. The typical West Indian form of the species has been imported into Europe with tropical plants, and was first observed by Forel in the hot-houses of Switzerland. He says of this ant (1895): "I have observed specimens of *Brachymyrmex heeri* Forel with the gaster enormously distended with honey, but nevertheless running on the plants outside the nest; they had merely gorged themselves with the honey-dew of coccids and were returning home."

2. **Melophorus bagoti** *Lubbock.*

The Australian genus *Melophorus* is so closely related to *Myrmecocystus* that one of its species, *M. æneovirens* was long considered to belong to this genus. That *Melophorus* is also fond of living in arid regions is shown by the remarkable development of the ammochætæ or long circumoral bristles used in cleaning the fore legs and strigils. As I have shown in a former paper (1907a), all the series of these hairs (clypeal, mandibular, mental and gular) are present in *Melophorus*. In the New World *Myrmecocysti*, however, there are none on the mentum and in the Old World species there is a tuft on the mentum but none on the gula.

The genus *Melophorus* was based by Lubbock on *M. bagoti* in 1884. The types came from Central or Western Australia ("21° S. Lat."). Lubbock transposed the generic and specific diagnoses that had been written out for him by Forel, but the latter rectified the blunder a few years later (1886). *M. bagoti* is of a rich ferruginous red color and has polymorphic workers. The length of the smaller ones has not been recorded but that of the larger is 13–16 mm. In the latter the gaster is distended somewhat as in the *Nylanderia* repletes, and, as Forel has stated, is far from attaining the amplitude of *Myrmecocystus.* The insect is undoubtedly able to walk about and in all probability does not hang from the roof of its galleries.

During the summer of 1907 Professor Forel kindly gave me a replete of *M. bagoti,* from which the accompanying figure was drawn (Fig. 27).

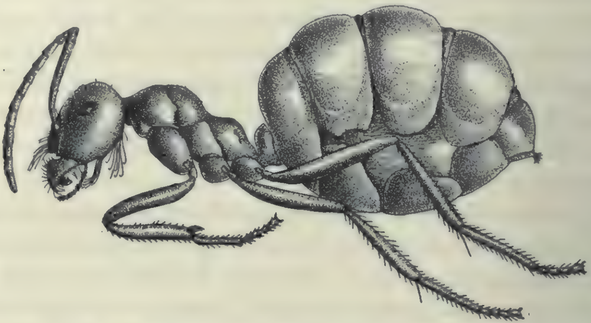


Fig. 27. *Melophorus bagoti* Lubbock, replete. × 5.

In this specimen the gastric sclerites are greatly enlarged. Apparently they were originally much smaller but along their borders the intersegmental membranes seem to have hardened and turned brown secondarily. The lines representing the original lateral borders of the sclerites are shown in the figure.

3. **Melophorus cowlei** (*Froggatt*).

Froggatt (1896) described this ant as a *Camponotus,* but his figures and description show very clearly that it is a typical *Melophorus,* closely related to *bagoti.* Comparison of Froggatt's figures with Lubbock's and with the replete of *bagoti* in my collection, shows that the head in this species is broader than long and somewhat narrower in front than behind, whereas that of *cowlei* is distinctly longer than broad. This species also has a narrower thorax and the petiole of a different shape, judging from Froggatt's rather inadequate description. The replete, which measures 17 mm. has the gaster distended to much the same extent as that of *bagoti,* but the sclerites seem to be shorter and the intersegmental membranes larger.

Froggatt described all three phases of *M. cowlei* from specimens taken at Illamurta in the James Range and Spencer Gorge in the McDonnell Range, in the very center of Australia. He says that this ant is known to the natives as the "Ittootoonee" and gives the following notes sent him by Baldwin Spencer: "I came across a single nest of the golden yellow species, which was a small one, consisting of branching passages close to the surface, under a little block of quartzite in one of the gorges amongst the McDonnell Ranges. In this nest the honey ants, though considerably swollen out, seemed to be able to move about slowly. Perhaps it was a young colony and they were not fully developed."

4. **Leptomyrmex varians** *Emery* var. **rufipes** *Emery.*

This is the only honey ant known to occur among the Dolichoderinæ. The genus *Leptomyrmex,* which is confined to Australia and New Guinea, is characterized by its very slender and emaciated body, extremely long legs and singular head. In 1882 Forel published the following note on *L. rufipes*: "In the excavated nests of this variety Mr. Turner found workers with the gaster considerably dilated by the crop full of transparent honey. The gaster resembled that of *Myrmecocystus,* without, however, attaining such dimensions." In an alcoholic specimen of this ant which I saw in Prof. Forel's collection, the gaster appeared to be much more distended than in the repletes of *Nylanderia* and *Melophorus.*

5. **Plagiolepis trimeni** *Forel.*

This species was discovered by Mutschinson at Natal and described by Forel in 1895. The types were all repletes, 6.5 mm. in length, of which the head and thorax together measured only 2 mm. They are described as being of a "sordid brownish yellow color, more reddish on the head and thorax; the sides of the gastric segments brownish; feet and antennæ yellowish." The gaster "is distended with honey, like a round cyst, transparent, as large as a hemp seed, on which the chitinous laminæ of the segments appear as islands. The anterior portion of the first segment has a hollow depression in which fits the petiolar scale. With the aid of a lens it is possible to distinguish, below and behind, the stomach and gizzard with its reflected calyx, both of them displaced and flattened against the gastric wall." Forel further states that the gaster is "nearly as fully distended as that of *Myrmecocystus melliger* . . . . Locomotion must be almost impossible for this insect. Its appearance is that of a *Myrmecocystus* nurse *en miniature.*" *P. trimeni* therefore represents a stage of repletion intermediate between *Nylanderia* and *Melophorus* on the one hand and *Myrmecocystus* on the other.

6. **Camponotus inflatus** *Lubbock.*

Lubbock described the worker of this ant in 1880 from specimens taken at Adelaide, Australia. His diagnosis was, however, so imperfect that the insect had to be redescribed by Forel (1886). McCook (1882) has also studied and figured this species (1882, Figs. 71 and 74). According to Forel, it "has nothing to distinguish it particularly from other *Camponoti*, except the purely physiological distension of its gaster, evidently due to the enormous plenitude of the crop, as in *Myrmecocystus melliger*. This dilatation, however, is smaller than that of *melliger*."

More recently (1896) Froggatt has described the male and female of *C. inflatus* from specimens collected at Ayers Rock, Illamurta in the James Range of Central Australia. All three phases of this ant are black with paler legs and antennæ. The repletes measure 17 mm. Froggatt records the following notes sent him by Baldwin Spencer: "The black honey ant (*Camponotus inflatus* Lub.) is called 'Yarumpa' by the natives, by whom it is esteemed a great luxury; it is, *par excellence*, the honey ant of the central country, and ranges across the Murchison in Western Australia. We found them plentiful in certain districts on the hard sandy plains, and also very abundant in patches among the Mulga scrub. The ground all round Ayers Rock, to the south of Lake Amadeus, was strewn with heaps of sand where the natives had been digging them out. They construct no mounds over their nests; the entrance, which is an inch in length by a quarter of an inch in width, leads down into a vertical shaft or burrow from five to six feet in depth. About a foot below the surface horizontal passages about a foot in length lead off from the main shaft, at the end of which were three or four of the honey ants, while the bottom of the main shaft, which is excavated into a larger cavity, contained a considerable number. The 'honey ants' are quite incapable of movement and must be fed by the workers. Unlike all the other ants noticed in this country, these did not appear to collect twigs, leaves or grass to carry into their burrows."

7. **Cremastogaster inflata** *F. Smith* and **C. difformis** *F. Smith.*

As Frederick Smith's original account of these two Myrmicine ants (1857, 1858) has led to their being regarded as honey ants, we may properly include them in the present survey. Both species range from Tenasserim to Borneo through Burma, Java and Sumatra. *C. inflata* occurs also in the Philippines and *difformis* in Celebes. Of the latter species Emery has described a subspecies *physothorax* and a variety *mucronata*. In all these ants the gaster remains unmodified but the epinotum, or posterior portion of the thorax is greatly enlarged in *difformis* and even inflated in *inflata* (Fig. 28). In this species it is also of a honey-yellow color unlike the remainder of the body which is dark brown or black. Emery (1900) has also described another species, *C. tumidula* from Sumatra, which shows an incipient stage in the expansion of the epinotum.

Smith stopped long enough in the series of his often hopelessly inadequate specific diagnoses to pen the following remarks on *C. inflata*: "This is one of those singular and anomalous species, which, without any particle of information, derived from observation, puzzle and perplex the naturalist; what can possibly be the use of the bladder-like excrescence on the thorax of this insect, it is difficult to imagine; to the touch it is elastic, and apparently forms a receptacle for saccharine fluids. With the aid of a microscope, a small circular orifice can be seen at each of the posterior lateral angles of the swollen part, and small crystallized particles are apparent, not only within the orifice, but scattered over the surface of the inflation; we may, therefore, reasonably suppose that this singular apparatus is for the purpose of elaborating a suitable and necessary aliment for the larvæ of this singular insect." Of *C. difformis* he says: "This species resembles the *C. inflatus* in form; but the swollen portion of the thorax is of a solid consistency; it forms, however, a similar laboratory of saccharine matter; the orifice from which it exudes is not exactly at the posterior angles, but a little way beneath; in some specimens, masses of crystallized particles can be seen beneath the orifice of this species, both large and small workers have been examined, and the same apparatus is found on them both."

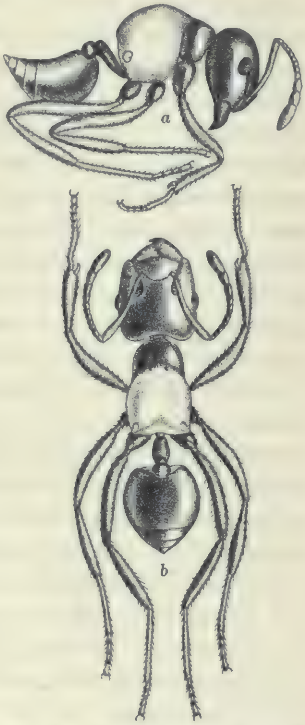


Fig. 28. *Cremastogaster inflata* F. Smith, worker; *a*, lateral, *b*, dorsal view. × 8.

More recently Bingham (1903) has made a few observations on these ants which he describes as follows: "*C. difformis, physothorax* and *inflata* have the metathorax remarkably large and swollen, with a hollow in each side interiorly, communicating exteriorly by a tiny aperture. In live specimens there seems to be a continual flow from this aperture of a sweet fluid, and I have watched the workers of *C. physothorax* licking one another's thoraces vigorously."

These brief but interesting notes do, indeed, leave the reader in some perplexity. Janet (1898) surmised that the epinotal enlargement in *C. inflata* might be due to hypertrophy of the peculiar glands which he, Meinert and Lubbock had found in this portion of the thorax of our northern ants. These structures, which Janet studied and figured with great care, consist of a pair of chambers each opening to the exterior by means of a button-hole-shaped orifice on the metasternum. The glands proper open into these chambers, which contain hair-like organs apparently for the diffusion of the secretion. In a number of specimens of *C. inflata* in my collection, from Zamboangan, Philippines, two broadly elliptical or nearly circular openings are seen on each side of the epinotum (see Fig. 28*a*). The upper, which is somewhat smaller, is the tracheal orifice, or stigma, the lower is undoubtedly the external opening which leads directly into one of the large inflated cavities. As all of my specimens are dry and carded, I am unable to ascertain the histological structure of these organs. I am convinced, however, that they represent, as Janet supposed, an enormous development of the organs found in the corresponding portion of the epinotum of our common ants. This is also indicated by an examination of specimens of *C. difformis* from Perak and of *mucronata* from Sumatra. In these the openings of the epinotal chambers are more ventral and more slit-shaped than in *inflata*, and may therefore be described as intermediate between those of *inflata* and our northern species of *Cremastogaster*.

As the function of the metasternal glands even in our common ants is still unknown, we can hardly expect to form a satisfactory conception of the hypertrophied homologues of these organs in a few Indomalayan species that have hardly been studied in a living condition. That these organs should secrete a sweet liquid to be fed to the ants or to their young is surprising at first thought and suggests the nursing habits of the Mammalia, but when we stop to consider that ants are in the habit of feeding their young and one another with a secretion of the labial, or salivary glands, we can see no reason why, in certain species, thoracic glands might not be developed for a similar purpose. It will be very interesting, nevertheless, if future investigation proves that certain species of *Cremastogaster*, a genus whose members are so conspicuously fond of feeding on the saccharine excrement of aphids and coccids, have themselves developed a capacity for distilling a substance resembling honey dew. It should be possible, since *C. inflata* occurs in the Philippines, for some of our entomologists, who have an opportunity to visit these islands, to investigate this interesting subject which was first suggested by Frederick Smith half a century ago.

CONCLUSION.

In the foregoing pages the habit of developing repletes has been shown to recur sporadically in some six different genera of ants, namely, *Prenolepis, Melophorus, Plagiolepis, Leptomyrmex, Camponotus* and *Myrmecocystus.* We are therefore dealing with a case of convergent development and as in other cases of this kind, we are led to determine the external conditions that must act as the common stimulus in calling forth this peculiar adaptation on the part of such different ants. The geographical distribution of the various honey ants points to drought as one of the most important of these conditions, for nearly all of these insects are confined to the dry plains and deserts of North America, South Africa and Australia. Forel seems to be the only author who has noticed this peculiarity in the distribution of these insects. He says (1902): "The extraordinary distension of the crop seems to be frequent in the Australian species of the genera *Melophorus, Camponotus* and *Leptomyrmex.* I suppose that this is due to the extremely dry climate of the country, which must compel the ants to remain, often for long periods, in their subterranean abodes. At such times a store of provisions in living bags must be very useful to them."

There can be little doubt of the truth of this statement, but I believe that it should be expressed in a different manner. The impulse to develop repletes is probably the brief and temporary abundance of liquid food (honey dew, gall secretions, etc.) in arid regions and the long periods during which not only these substances but also insect food are unobtainable. The honey is stored in the living reservoirs for the purpose of tiding over such periods of scarcity, and the ants remain in their nests because they do not need to forage. Hence the confinement mentioned by Forel is not the immediate but one of the ulterior effects of drought, for I am convinced from my observations on desert ants that no amount of dryness will keep these insects in their nest when they are in need of food.

Nylanderia imparis would seem to be an exception to the general rule of distribution in the honey ants, since the typical form of this species occurs in rather shady places and in clayey soil which holds moisture rather tenaciously. It is not improbable, however, that what is known as var. *testacea* Emery is really the ancestral form of this species. This ant nests in sandy soil and is one of the most abundant insects in the pine barrens of New Jersey and in similar localities in the Eastern States. Now these are xerophytic regions, as shown by the pines, scrub oaks and many other plants, and the sand in which this vegetation grows does not retain water readily and therefore presents conditions not unlike those of the deserts and great plains.

The dark colored typical *imparis* is much less abundant and probably represents a secondary adaptation to moist woods and firmer soil. This would account for the persistence of repletes in an ant inhabiting rather humid, shady localities.

Most ants of temperate, mesophytic regions have a mixed diet, consisting of insects, honey dew and plant excretions. When such species come to live in deserts or other arid regions, where the long droughts of summer and the cold of winter restrict plant and insect life to a brief season, they usually take on one of the four following adaptations:

1. They may exaggerate the insectivorous habits which they already possess, and become intrepid, ravenous, hunters. They thus manage to secure a sufficient amount of food even under unfavorable conditions. This adaptation is beautifully shown in the Old World *Myrmecocysti* which are represented by the greatest number of species, subspecies and varieties in the deserts of North Africa. The same tendency, however, is apparent in the American races *orbiceps* and *mendax*.

2. Many species have taken to eating and harvesting seeds — a very obvious adaptation to arid regions covered with a short-lived herbaceous flora, as is shown by the species of *Pogonomyrmex* in the New World, *Messor*, *Solenopsis* and *Pheidole* in both hemispheres, and *Holcomyrmex*, *Oxyopomyrmex*, *Goniomma*, *Meranoplus* and *Pheidologeton* in the Old World. These ants still feed upon insects when these are obtainable, but seeds furnish such an inexhaustible and nutritious food supply that the habit of collecting and storing them in the nests has become highly developed.

3. A number of species, the honey ants, which have been described in the foregoing pages, have taken to storing the sweet exudations of plants and the excretions of aphids and coccids in the crops of a physiological caste, the repletes.

4. Some ants manage to live and thrive in arid regions because they cultivate and eat fungi. This habit, which I have described in detail in a recent article (1907b), is peculiar to a single tribe of American Myrmicine ants, the Attii, and probably originated in the luxuriant rain-forests of the tropics. Thence several of the species have migrated into the deserts of Northern Mexico and the southwestern states, where they can always obtain the vegetable débris for the substratum on which to grow their fungi and where these delicate plants can be successfully cultivated some distance below the dry surface of the soil.

LITERATURE.

1881–'85. **André, Ernest.** Species des Formicides d'Europe. Gray (Haute-Saône), 1881–1882; Supplement, 1885; 2^{me} Supplement, 1885.

1890. **Bassett, H. F.** New Species of North American Cynipidæ. *Trans. Amer. Entom. Soc.*, XVII, 1890, pp. 59–92.

1903. **Bingham, C. T.** The Fauna of British India, including Ceylon and Burma. Hymenoptera II, Ants and Cuckoo Wasps. London, Taylor and Francis, 1903, xix, 506 pp., 1 pl., 161 text figg.

1873. **Blake, James.** On the Structure of the Honey-bag in the Honey-making Ant Myrmecocystus Mexicanus. *Proceed. Calif. Acad. Sci.*, V, 1873, p. 98.

1873. **Edwards, Henry.** Notes on the Honey-Making Ant of Texas, and New Mexico, Myrmecocystus Mexicanus of Westwood. *Proceed. Calif. Acad. Sci.*, V, 1873, pp. 72–75, 1 fig.; *Amer. Natur.*, VII, 1873, pp. 722–726, 1 fig.

1878. **Emery, Carlo.** Catalogo delle Formiche sistenti nelle Collezioni de Museo Civico di Genova. Parte II Formiche dell'Europa e delle regioni limitrope in Africa e in Asia. *Ann. Mus. Civico Stor. Natur. Genova,* XII, 1878, pp. 44–59.

1884. **Emery, Carlo.** Materiali per lo studio della fauna tunesina raccolti da G. e L. Doria. Rassegna delle Formiche della Tunisia. *Ann. Mus. Civ. Stor. Nat. Genova* (2), I, 1884, pp. 373–386.

1891. **Emery, Carlo.** Revision Critique des Fourmis de la Tunisie. In Explor. Scient. de la Tunisie. Zool. Hyménopt., 1891, 21 pp.

1898. **Emery, Carlo.** Beiträge zur Kenntniss der paläarktischen Ameisen. *Ofversigt af Finska Vet. Soc. Förhandlingar,* XL, 1898, pp. 124–151.

1900. **Emery, Carlo.** Formiche Raccolti da Elio Modigliani in Sumatra, Engano e Mentawei. *Ann. Mus. Civico Stor. Natur. Genova,* (2), XX (XL), 1900, pp. 661–722, 16 figg.

1906. **Emery, Carlo.** Rassegna Critica delle Specie palearctiche del genere Myrmecocystus. *Mem. R. Accad. Sci. Ist. Bologna* (6), III, 1906, pp. 173–187, 35 figg.

1902. **Escherich, Karl.** Zur Biologie der nordafrikanischen Myrmecocystus-Arten (Formiciden). *Allgem. Zeitschr. f. Entomol.*, VII, 1902, no. 18, 19, pp. 353–359, 390–394, 2 figg.

1880. **Forel, Auguste.** An Weingeist-Exemplaren der Honigameise (Myrmecocystus melliger Llave = M. mexicanus Wesmael) gemachten Beobachtungen. *Mitth. morph. phys. Gesell. München,* Jan. 1880, pp. 1, 2.

1886. **Forel, Auguste.** Études Myrmécologiques en 1886. *Ann. Soc. Entom. Belg.*, XXX, 1886, pp. 131–215.

1890a. **Forel, Auguste.** Fourmis de Tunisie et de l'Algérie Orientale. *Compt. Rend. Soc. Entom. Belg.*, XXXIV, 1890, pp. lxi–lxxvi.

1890b. **Forel, Auguste.** Eine Myrmekologische Ferienreise nach Tunesien und Ostalgerien. *Humboldt,* IX, Heft 9, 1890, p. 296 et seq.

1894. **Forel, Auguste.** Les Formicides de la Province Oran. *Bull. Soc. Vaud. Sc. Nat.*, XXX, no. 114, 1894, pp. 1–45, pll. I, II.

1895. **Forel, Auguste.** Une Nouvelle Fourmi Melligére. *Ann. Soc. Entom. Belg.*, XXXIX, 1895, pp. 429, 430.

1902a. **Forel, Auguste.** Les Fourmis du Sahara Algérien. *Ann. Soc. Entom. Belg.*, XLVI, 1902, pp. 147–158.

1902b. **Forel, Auguste.** Fourmis d'Algérie. *Ann. Soc. Entom. Belg.*, XLVI, 1902, pp. 462, 463.

1902c. **Forel, Auguste.** Fourmis Nouvelles d'Australie. *Rev. Suisse de Zool.*, X, 1902, pp. 405–548.

1896. **Froggatt, W. W.** Honey Ants. Report Horn Exped. to Centr. Australia. Zool., Pt. II, Feb. 1896, pp. 385–392, pl. xxvii.

1898. **Janet, Charles.** Études sur les Fourmis, les Guêpes et les Abeilles. Note 17. Système glandulaire tégumentaire de la Myrmica rubra; Observations diverses sur les Fourmis. Paris, Carré et Naud, 1898, 30 pp. 9 figg.

1905. **Kellogg, V. L.** American Insects. New York, Henry Holt & Co. 1905.

1902. **Lameere, Auguste.** Note sur les Moeurs des Fourmis du Sahara. *Ann. Soc. Entom. Belg.*, XLVI, 1902, pp. 160–169.

1852. **Langstroth.** [Honey-ants from Matamoras, Mexico.] *Proceed. Acad. Nat. Sci. Phila.*, VI, 1852, p. 71.

1852. **Leidy, Joseph.** [Anatomy of Honey-ants.] *Proceed. Acad. Nat. Sci. Phila.*, VI, 1852, p. 72.

1832. **de Llave, Pablo.** Registro Trimestre o Collection de Memorias de Historia, Literatura, Ciencias y Artes, Mexico, 1832.

1874. **Loew, Oscar.** The Honey Ants. *Amer. Natur.*, VIII, 1874, pp. 365, 366.

1881. **Lubbock, Sir John.** Observations on Ants, Bees and Wasps; with a Description of a New Species of Honey-Ant. Part VII, Ants. *Journ. Linn. Soc. Zool.*, XV, 1881, 167–187, pl. viii.

1884. **Lubbock, Sir John.** Observations on Ants, Bees and Wasps. Part X. With a Description of a New Genus of Honey-ant. *Journ. Linn. Soc. Zool.*, XVII, 1884, pp. 41–52, pl. ii.

1894. **Lubbock, Sir John.** Ants, Bees and Wasps. Internat. Sci. Ser. New York, Appleton & Co. Rev. ed. 1894, pp. 47–49, 428, 429, pl. iv, fig. 1.

1860. **Lucas, H.** Observations sur les Busileras, ou Fourmis à Miel du Mexique (Myrmecocystus melligerus). *Rev. et Mag. Zool.* (2), XII, 1860, pp. 271–280.

1879. **McCook, H. C.** On Myrmecocystus Mexicanus, Wesm. *Proceed. Acad. Nat. Sci. Phila.*, 1879, pp. 197, 198; Ann. Mag. Nat. Hist. (5), IV, 1879, p. 474.

1882. **McCook, H. C.** The Honey Ants of the Garden of the Gods and the Occident Ants of the American Plains. With 13 pll. Phila., Lippincott & Co. 1882.

1906. **McCook, H. C.** Honey Ants of the Garden of the Gods. *Harper's Monthly*, June, 1906, pp. 126–133, 6 figg.

1880a. **Morris, C.** Living Honey Comb; a Novel Phase of Ant Life. *Journ. Sci.*, Feb. 1880.

1880b. **Morris, C.** Habits and Anatomy of the Honey-bearing Ant. *Journ. Sci.*, July, 1880.

1880. **Riley, C. V.** Honey-producing Oak-Gall. *Amer. Entomol.*, 1880, p. 298.

1883. **Romanes, Geo. J.** Animal Intelligence. Internat. Sci. Ser. New York, Appleton & Co., 1883.

1875. **Saunders, W.** The Mexican Honey Ant (Myrmecocystus mexicanus). *Canad. Entomol.*, VII, 1875, pp. 12, 13, 1 fig.

1857. **Smith, Frederick.** Catalogue of the Hymenopterous Insects collected at Sarawak, Borneo; Mount Ophir, Malacca; and at Singapore, by A. R. Wallace. *Journ. Proceed. Linn. Soc. Zool.*, II, 1857, pp. 42–130, pl. I, II.

1858. **Smith, Frederick.** Catalogue of Hymenopterous Insects in the Collection of the British Museum. VI, Formicidæ, London, 1858, 216 pp., 14 pll.

1884. **Wasmann, E.** Die Honigameise des Göttergartens. *Stimmen aus Maria Laach*, 1884, pp. 275–285.

1838. **Wesmael, C.** Sur une Nouvelle Espèce de Fourmi du Mexique. *Bull. Acad. Roy. Sci. Brux. Bell. Lettr.*, V, 1838, pp. 766–771, pl. xix, figg. 1–4.

1852. **Wetherill, Chas. M.** Chemical Investigation of the Mexican Honey Ant. *Proceed. Acad. Nat. Sci. Phila.*, VI, 1852, pp. 111, 112.

1905. **Wheeler, W. M.** An Annotated List of the Ants of New Jersey. *Bull. Amer. Mus. Nat. Hist.*, XXI, 1905, pp. 371–403, 4 figg.

1907a. **Wheeler, W. M.** On Certain Modified Hairs Peculiar to the Ants of Arid Regions. *Biol. Bull.*, XIII, 4, 1907, pp. 185–202, 14 figg.

1907b. **Wheeler, W. M.** The Fungus-Growing Ants of North America. *Bull. Amer. Mus. Nat. Hist.*, XXIII, 1907, pp. 669–807, pl. xlix–liii, 31 text-figg.

59.57,96(735W)

Article XXI.— THE ANTS OF TEXAS, NEW MEXICO AND ARIZONA.

(Part I.)

By William Morton Wheeler.

Plates XXVI and XXVII.

Although the ant-fauna of Texas, New Mexico and Arizona comprises a greater number of species than that of the whole remaining portion of America north of Mexico, it has never been made the subject of systematic investigation. In the following study I have brought together the scattered and rather meager materials published by previous authors and have added several new forms, especially of *Pheidole*, a cosmopolitan genus represented by a great number of species in tropical and subtropical America. A residence of four years (1899–1903) in central Texas, several excursions to the Trans Pecos deserts of that State, and a journey through New Mexico and Arizona during the spring of 1905, have enabled me not only to secure the large series of specimens now deposited in the American Museum of Natural History, but also to observe the living ants in their natural environment. This, as every myrmecologist knows, is often of the greatest importance in determining the status of species, subspecies and varieties.

In obtaining material for the following study from a number of localities which I have been unable to visit, I have received generous assistance from several collectors, especially from Messrs. C. F. Baker, J. H. Batty, C. R. Biedemann, C. T. Brues, T. D. A. Cockerell, C. G. Hartmann, H. Heath, G. von Krockow, W. H. Long, J. F. McClendon, A. L. Melander, C. Schaeffer, H. Skinner, C. H. T. Townsend, E. S. Tucker and H. Viereck, and Misses Mary Cooper, Lillie Gerhardt, Margaret Holliday, Clara Klaumann, Anna Pritchett, and Augusta Rucker. These collectors have, indeed, contributed a large part of the more valuable data recorded in the following pages.

Family FORMICIDÆ.

Subfamily Ponerinæ.

1. **Stigmatomma pallipes** (*Haldeman*).

Typhlopone pallipes Haldeman, Proc. Acad. Nat. Sci. Phila., II, 1844, p. 54, ☿.

Arotropus binodosus Provancher, Natural. Canad., XII, 1881, p. 207, ♀, fig. 32, 33; Entom. Canad. Hymén., 1883, p. 539, ♀, figs. 73 and 74.

Amblyopone binodosus Provancher, Addit. Faun. Canad. Hymén., 1887, p. 240, ☿, ♂, fig.

Stigmatomma pallidipes Dalla Torre, Catalog. Hymenopt., VII, 1893, p. 14.

Stigmatomma pallipes Emery, Zool. Jahrb., Abth. f. Syst., VIII, 1894, pp. 261, 262, ☿ ♀ ♂; Wheeler, Biol. Bull., II, No. 2, 1900, p. 56 et seq., figs. 5–7.

A single worker taken under a stone in Shoal Creek, Austin, Texas, by Mr. C. T. Brues. This is the only record of the occurrence of this subboreal ant at so low a latitude.

2. **Acanthostichus texanus** *Forel.*

Forel, Ann. Soc. Ent. Belg., XLVIII, 1904, pp. 168, 169, ♀.

"*Female.* Length: 5.6 mm.

The whole body, which is narrow and cylindrical, is nowhere more than 0.8 mm. broad (0.6–0.8). Mandibles trenchant, smooth, shining, strongly curved downward, with only a few scattered punctures. Eyes situated behind the middle, at the third fifth of the head. Head subrectangular, much longer than broad, distinctly broader behind than in front, broadly excised behind. Thoracic dorsum hardly convex, without a distinct border, shouldered and barely submarginate, with the dorsal portion as long as the scutellum. Basal surface of epinotum nearly square, but passing over onto the sides and declivity through a rounded though sudden curve. Node of petiole forming nearly a rectangular parallelopipedon, $\frac{1}{6}$ to $\frac{1}{5}$ longer than broad, a little higher behind than in front and with all its sides rounded as in the case of the basal surface of the epinotum. The anterior border is a little more suddenly, the lateral borders on the contrary, more evenly rounded. The petiole bears a backwardly curved tooth on its lower surface. First gastric segment more elongate than in *serratulus*; pygidium less depressed, bordered with a shorter series of less numerous but equally long spinules. Antennæ and legs short and thick. The scapes, which are considerably arched, reach only half way to the posterior corners of the head; funicular joints very short and thick. Antennæ 12-jointed. Wings lacking.

Perfectly smooth and very shining. Pilosity erect and fine, yellowish, pointed, of medium length, rather sparse both on the tibiæ and the scapes. Pubescence very much scattered but distinct and rather coarse.

Reddish brown. Legs, antennæ, mandibles and venter of a somewhat yellowish red.

Brownsville, Texas. (Wickham).

This species is very distinct from the others in lacking the sharp thoracic and petiolar margin, and in its more elongate shape. It approaches *brevicornis* Emery." (Forel.)

3. **Cerapachys (Parasyscia) augustæ** *Wheeler.*

Wheeler, Biol. Bull., III, 1902, pp. 181–184, figs. 1 and 2, ☿ ♀; Psyche, Oct.–Dec., 1903, pp. 205–209, fig.

Of this interesting form I have seen specimens from only two colonies, one taken by Miss Augusta Rucker, the other by myself at Austin, Texas. It lives in small communities under large stones and is hypogæic in its habits.

4. **Proceratium croceum** *Roger.*

Emery (Zool. Jahr., Abth. f. Syst., VIII, 1894, p. 264) mentions a worker of this species from Texas.

5. **Platythyrea punctata** *F. Smith.*

Platythyrea punctata F. Smith, Catalog. Hymen. Brit. Mus., VI, 1858, p. 108, No. 9, ☿ ♂. Forel, Rev. Suisse. Zool., IX, 1901, p. 335, 336; Wheeler, Bull. Am. Mus. Nat. Hist., XXI, 1905, pp. 80, 81, fig. A–C.
Platythyrea inconspicua Mayr, Verh. zool. bot. Ges. Wien, XX, 1870, p. 961, ♀; Emery, Ann. Soc. Ent. France (6) X, 1890, p. 56, ☿.
Platythyrea pruinosa Mayr, Verhand. zool. bot. Ges. Wien, XX, 1870, p. 962, ☿; Forel, Trans. Ent. Soc. London, 1893, p. 358, 359, ☿ ♂.

There is a specimen of this species from Brownsville, Texas, in the United States National Museum. It may also be expected to occur in Southern Florida, as I have taken it as far north as New Providence in the Bahamas.

6. **Pachycondyla harpax** *F. Smith.*

Ponera amplinoda Buckley, Proc. Ent. Soc. Phila., VI, 1866, p. 171, No. 33, ☿.
Pachycondyla harpax F. Smith Emery, Zool. Jahrb., Abth. f. Syst., VIII, 1894, p. 266, ☿; Forel, Biol. Centr. Am., Hymen., III, 1899–1900, p. 12; Wheeler, Biol. Bull., II, 1900, pp. 1–31 passim, figs. 2, 3, 8.

Worker. Length: 7–8.5 mm.

Head, excluding the mandibles, a little longer than broad, slightly broader through the eyes which are well in front of the middle of the head; sides straight and subparallel, the posterior border broadly excised. Mandibles large, with about 10 teeth and with concave external borders. Clypeus broadly rounded in front, very convex in the middle. Cheeks without a carina. Antennæ rather robust, scapes not quite reaching the posterior corners of the head; four basal and the terminal joint of funiculus distinctly longer than broad, remaining joints about as broad as long. Thorax rather flat above, pronotum with an impressed median line and a sharp margin on each side; promesonotal suture very distinct, mesoëpinotal suture obsolescent. Epinotum with a flattened basal surface much shorter than the declivity which is also flattened, bounded on each side by a crenated margin, and passing over into the basal surface through a rounded obtuse angle. Petiole very thick, as high as the epinotum in profile, with flat anterior and posterior surfaces, as long above as below, with the upper surface faintly rounded. Seen from above it is broader than the epinotum, hardly broader than long, with a straight posterior border and the outline of the front and sides forming a semicircle. Gaster truncated in front, with a very indistinct constriction behind the first segment, rather rapidly tapering and with a powerful sting. Legs robust.

Mandibles and clypeus somewhat shining, the former rather finely and irregularly punctate, the latter rugulose. Head and thorax opaque, punctate-rugulose, sides of latter finely longitudinally striated. Petiole and gaster somewhat more shining, finely and densely shagreened or punctulate.

Hairs and pubescence yellowish gray, the former coarse, erect, moderately abundant, and present also on the antennal scapes; the latter most abundant and longest on the gaster.

Black; mandibles, clypeus, frontal carinæ, antennæ, tip of gaster, sting, coxæ, and legs dark red; scapes, coxæ and femora often darker or quite black, except at their articulations.

Female. Length: 8–9 mm.

Very closely resembling the worker except in the usual sexual characters. The petiole is higher and not so thick anteroposteriorly, and distinctly broader than long when seen from above. The wings are brownish hyaline, with yellow veins and brown stigma. The upper surface of the pro- and mesonotum and scutellum is coarsely and rather densely punctate. Mandibles and middle of clypeus smooth and shining, the former with large and widely scattered punctures.

Male. Length: 7–8 mm.

Head, excluding the eyes, about as broad as long, rounded behind, with very short cheeks. Mandibles very small and far apart, rapidly tapering to a truncated, minutely denticulate tip. Clypeus carinate in the middle, with a sinuous anterior border. Antennæ very long and slender, first joint twice as long as the second but only about ⅓ as long as the third joint. Joints 3–13 very long and cylindrical, the basal being somewhat longer than the terminal. Thorax through the wing insertions as broad as the head through the eyes, pro-mesonotum convex above, the latter with distinct Mayrian furrows. Epinotum rounded, without distinct basal and declivous surfaces, with a prominent V-shaped ridge, which has its point directed forward and surrounds the flatter declivity. Petiole thick and rounded above and on the sides, not as high and not more than half as broad as the epinotum; seen from above it is fully ½ as long as broad and transversely elliptical. Gaster with a distinct constriction between the first and second segments. Legs slender.

Body somewhat shining. Head finely and densely punctate. Thorax above indistinctly punctate, with sharply, longitudinally striated pleuræ. Epinotum irregularly and transversely rugose, the rugæ converging and becoming confluent with the V-shaped ridge. Petiole and gaster very minutely and inconspicuously punctate.

Pile and pubescence similar to those of the worker and female, but less abundant, especially on the thorax.

Black; mandibles, mouthparts and legs sordid yellow; femora more or less infuscated. Wings like those of the female.

Texas: Austin, Del Rio (Wheeler); Barksdale (Brown); Brownsville (C. Schæffer).

Louisiana (Mrs. A. T. Slosson).

This species is abundant in Central Texas where it nests in small colonies under stones and logs. The workers move about in the early morning in the shade of the vegetation in search of insect food. The nests are irregular galleries and chambers in the soil. The larvæ are tuberculate and are fed on pieces of insects and myriopods. For a fuller account of the habits of this ant see my paper "A Study of Some Texan Ponerinæ" (Biol. Bull., II, 1900, pp. 1–31).

7. **Neoponera villosa** (*F. Smith*).

Pachycondyla villosa Dalla Torre, Catalog. Hymenopt., VII, 1893, p. 35; Forel, Biol. Central. Am., Hymenopt., III, 1899–1900, p. 14.

Neoponera villosa Emery, Ann. Soc. Ent. Belg., XLV, 1901, p. 47.

Worker. Length: 12–13 mm.

Head, excluding the mandibles, a little longer than broad, with faintly rounded, subparallel sides and broadly excised posterior margin. Eyes large and convex, in front of the middle of the sides. Cheeks with a sharp carina extending from the eye to the clypeal border. Between this ridge and the antennal insertions the surface is concave. Mandibles with faintly concave outer borders and about 13 subequal teeth. Clypeus convex in the middle, with a slight median excision in its anterior border. Antennæ moderately long; scapes surpassing the posterior angles of the head by about their own breadth; funicular joints all distinctly longer than broad. Thorax long and narrow, but little broader in front than behind. Pronotum with angular humeri and sharp lateral borders. Promesonotal and mesoëpinotal sutures distinct. Basal surface of epinotum flat, much longer than the sloping and somewhat concave declivity, which is bordered on the sides by strong anteriorly converging ridges. Petiole in profile with straight anterior and rounded posterior surface, the latter continuous with the dorsal surface, from above somewhat longer than broad and nearly as broad as the epinotum, triangular, with straight sides converging anteriorly, and with sharp semicircular upper border to the node. Gaster truncated in front, with a distinct constriction between the first and second segments. Sting long and powerful. Legs long.

Subopaque; mandibles covered with very fine longitudinal striæ and coarse, sparse punctures. Head, thorax and body densely punctate, the punctures on the head being somewhat larger than those on the remainder of the body.

Pile and pubescence golden yellow, on the posterior portion of the thorax and petiole silvery white; pile coarse, erect and sparse even on the antennal scapes, the pubescence abundant and more or less concealing the ground color and sculpture.

Black; mandibles, frontal carinæ, coxæ, legs, sting and in some specimens also part of the petiole, dark red.

Female. Length: 14 mm.

Closely resembling the worker except in the usual sexual characters. Wings brownish, with dark brown veins and stigma.

Male. Length: 12 mm.

Head, excluding the eyes, distinctly longer than broad, rounded and convex behind, with short cheeks. Mandibles very small and far apart, rapidly tapering to a blunt, edentulous point. Clypeus rather long, evenly convex. Antennæ very long and slender, scape thickened, twice as long as the first funicular joint but less than ½ as long as the second. Joints 2–13 very long but gradually diminishing in length distally. Thorax broader through the wing-insertions, than the head through the eyes. Epinotum narrow, convex and rounded. Petiole similar to that of the worker, but its node is much more rounded in profile; seen from above it is considerably longer than broad, rounded behind and with the sides slightly concave and converging in front. Gaster with a marked constriction between the first and second segments.

Sculpture, pilosity and coloration similar to those of the worker. Mandibles, mouthparts and subgenital plate yellowish.

Texas: Brownsville (C. Schaeffer); Alice and Kenedy (Wheeler); Victoria (Hunter).

This well-known species of tropical America occurs only in southwestern Texas and according to my observations does not extend farther north than San Antonio. Southward it is known to extend through Mexico, Central America, Brazil and Paraguay. At Kenedy I found a small colony nesting in the ground at the foot of a tree. The workers run about rapidly in the bright sun on trees and fence-posts in search of insect food.

8. **Ponera opaciceps** *Mayr.*

Ponera opaciceps Dalla Torre, Catalog. Hymenopt., VII, 1893, p. 40; Forel, Trans. Ent. London, 1893, p. 363, ☿; Emery, Zool. Jahrb., Abth. f. Syst., VIII, 1894, p. 267, ☿; Emery, Bull. Soc. Ent. Ital., XXVIII, 1896, p. 22; Forel, Ann. Soc. Ent. Belg., XLV, 1901, p. 124, ☿; Wheeler, Ann. Soc. Ent. Belg., XLV, 1901, p. 199, ☿; Wheeler, Bull. Am. Mus. Nat. Hist., XXII, 1906, p. 335, ☿.

This species is not uncommon under stones in moist places at New Braunfels, Granite Mountain and Austin, Texas, and in the lower portion of the Grand Canyon, Arizona. It occurs also in Mexico, the Antilles and Brazil and as far south as Montevideo (Silvestri). It is allied to our northern *P. coarctata pennsylvanica,* but the punctation of the head is extremely fine. It differs from *P. fœda* in its larger size (3.10 mm.) darker color and distinctly angular epinotum.

9. **Ponera trigona** *Mayr.* var. **opacior** *Forel.*

Forel, Trans. Ent. Soc. London, 1893, pp. 363, 364, ☿ ♀; Emery, Bull. Soc. Ent. Ital., XXVIII, 1896, p. 22, ☿.

Texas: Austin, McNeil, Marfa (Wheeler); Plano (E. S. Tucker); Paris (Miss Augusta Rucker).

New Mexico: Las Vegas (T. D. A. Cockerell).

Colorado: Canyon City (P. J. Schmitt).

California: Palo Alto (H. Heath).

Florida: Jacksonville (Mrs. A. T. Slosson).

Mexico: Ojos del Diablo, Chihuahua (C. H. T. Townsend).

In the worker of this species the eyes are situated at about the anterior fourth of the head, the maxillary palpi are 1-jointed, and joints 3–6 of the antennal funiculi are much broader than long.

10. **Ponera ergatandria** *Forel.*

Forel, Trans. Ent. Soc. London, 1893, pp. 365, 367, ☿ ♀ ♂; Emery, Bull. Soc. Ent. Ital., XXVIII, 1896, p. 22, ♀; Forel, Biol. Centr. Am., Hymenopt., III, 1899–1900, p. 16.

"*Worker.* Length: 2.3–2.9 mm.

Narrow and much elongated. Mandibles relatively short, with 4 teeth in front and distinctly denticulated behind. Clypeus short, rather strongly two-notched in front. Frontal furrow longer than half the distance from the frontal carinæ to the occiput. Eyes vestigial, of two or three facets, situated a little in front of the anterior fifth of the sides of the head. The scapes do not reach the posterior sixth of the head. The pronotum is longer than broad, much longer and narrower than in *P. fœda*, *trigona* and *opaciceps*, not enlarged at its anterior corners, which are absolutely effaced. Epinotum as is *P. contracta* but the basal surface is a little longer than the declivity, and the latter is not even marginate, but rounded on all sides. Petiole much narrower, lower and a little thicker than in *P. contracta*, otherwise of the same form. It is at least twice as broad as thick, of the same height as the first gastric segment. Gaster very long and narrow, hardly constricted behind the first segment, which is narrower, lower and less truncated in front than *P. fœda*, *contracta* and *punctatissima*. Legs much shorter than in any of these species.

Shining, finely punctate, like *P. contracta*, but the punctation of the head is finer.

Pilosity and pubescence longer and paler, very apparent.

Body sordid brownish yellow, with the lower portion of the head, certain portions of the thorax and the middle of the gastric segments deep brown. Legs antennæ, mandibles and tip of abdomen more or less pale, sordid yellowish or brownish.

Female. Length 2.7–2.9 mm.

Shorter and broader than the worker, otherwise presenting the same characters, but more deeply and strongly sculptured. Wings subhyaline; veins and stigma very distinct. Much smaller than the females of the European species.

Male. Length: 3 mm.

Apterous, ergatoid; much elongated and very narrow. In other respects extremely close to the dimorphic male of *P. punctatissima* (*P. androgyna* Roger), but still more closely resembling the worker from which it differs only in the following characters: It is blind, with a small pigment spot in place of the eyes. Head elongated, rectangular, ¼ longer than broad. The scapes hardly reach to the posterior fourth of the head and are subclavate. Funicular joints broader and more widely separated from one another. The teeth of the mandibles are somewhat more obtuse. The clypeus is a little longer and less vaulted. The gaster has one more segment and the male genital organs are altogether normal; the scales are large, the external genital valvules short, triangular. The pygidium has no spine and the hypopygium is rounded. Pale sordid yellow; antennæ and anterior portion of the head and middle of the gaster somewhat more brownish. The antennæ, moreover, are 12-jointed and the narrow thorax is in all respects like that of the worker." (Forel.)

Of this interesting species, which, as Forel has shown, has egatoid males, I have taken a few workers under stones along the sources of the Comal River at New Braunfels, Texas. Previously the species was known only from the island of St. Vincent and Costa Rica.

11. **Ponera inexorata** *Wheeler.*

Wheeler, Psyche, June, 1903, pp. 94, 95, ☿ ♀, fig. 2.

This ant occurs under stones in rather dry rocky places at Austin, San Angelo and Fort Davis, Texas. The worker differs from the other known North American forms, except *P. gilva*, in its larger size, and from all except this and *ergatandria* in its yellow color. The epinotum is not sharply marginate on the sides as in *gilva*, and the mandibular teeth are more numerous.

12. **Leptogenys (Lobopelta) elongata** (*Buckley*) *Wheeler.*

Ponera elongata Buckley, Proc. Ent. Soc. Phila., VI, 1866–67, p. 172, ☿.

Ponera texana Buckley, *ibid.*, p. 170, ☿.

Lobopelta septentrionalis Mayr, Verhandl. k. k. zool. bot. Ges. Wien, XXXVI, 1886, pp. 438, 439, ☿.

Leptogenys septentrionalis Emery, Zool. Jahrb., Abth. f. Syst., VIII, 1894, p. 268, ☿.

Leptogenys (*Lobopelta*) *elongata* Wheeler, Biol. Bull., II, 1900, pp. 2, 7, fig. 4, ☿ ♀ ♂; Trans. Tex. Acad. Sci., IV, pl. 2, No. 2, 1902, p. 9; Biol. Bull., VI, 1904, pp. 251–259, fig.

Texas: Austin, New Braunfels and Belton (Wheeler); Brownsville (C. Schaeffer).

Florida: Belleair (Mrs. A. T. Slosson).

Colorado (Cresson).

Maryland (Pergande, Mayr).

This interesting ant, as I have shown (Biol. Bull., VI, 1904, p. 251–259), feeds largely, if not exclusively on slaters (*Armadillidium, Oniscus*). There is no winged female but a gynæcoid worker that functions as the reproductive individual of the colony. The yellow males are nocturnal and fly to electric lights.

13. **Odontomachus clarus** *Roger.*

Odontomachus clarus Roger, Berl. Entom. Zeitschr., V, 1861, p. 26, No. 81, ☿; Dalla Torre, Catalog. Hymenopt., VII, 1893, p. 50; Forel, Ann. Soc. Ent. Belg., XLV, 1901, p. 124, ☿; Wheeler, Ann. Soc. Ent. Belg., XLV, 1901, p. 199. ☿.

Odontomachus texana Buckley, Proc. Ent. Soc. Phila., VI, 1867, p. 335, No. 37, ☿.

Odontomachus hæmatodes Wheeler, Biol. Bull., II, No. 1, 1900, *passim*, fig. 1.

Texas: Austin, San Antonio, Marble Falls, San Angelo, Milano, Alpine and Fort Davis (Wheeler); Meridian (W. H. Long).

Arizona: Huachuca Mountains (C. Schæffer).

Mexico: Cuernavaca (Wheeler), Guadalajara (J. F. McClendon).

This form may be regarded, as Forel suggests, as a pronounced subspecies of *O. hæmatodes* allied to the subspecies *insularis* Guérin and *hirsutiusculus* Smith. It differs from these forms and the typical *hæmatodes* in the following characters: In the worker the sculpturing of the head is much finer and leaves more of the sides and occipital region sparsely punctate and shining; the pronotum is transversely instead of longitudinally striated, and the petiole is not suddenly constricted above and then produced into a long point, but tapers more gradually to a short point. In the male the circular ridge on the epinotum is much feebler than in the male of *hæmatodes,* and the legs and antennæ are more deeply infuscated. The same difference obtains between the females of *clarus* and *hæmatodes* as between the corresponding workers, except in the sculpturing of the pronotum, which is transverse in both. The coloring of the head, thorax, petiole and legs is much lighter and more yellowish than in any of the forms of *hæmatodes* known to me, except the var. *pallens* Wheeler from the Bahamas. For an account of the habits, larvæ, etc., of *O. clarus* see my paper in the Biol. Bull., II, 1900.

Subfamily DORYLINÆ.

14. **Eciton cœcum** (*Latreille*).

(Pl. XXVI, Fig. 3.)

?*Formica omnivora* OLIVIER, Encycl. Method., Ins., VI, 1791, p. 496, No. 28, ☿.

Formica cœca LATREILLE, Hist. Nat. Fourm., IX, 1802, p. 270, fig. 56, ☿.

Labidus latreillei JURINE, Nouv. Méth. Class. Hymén., 1807, p. 283, ♂; LATREILLE, Gen. Crust. et Insect., IV, 1809, p. 123, ♂; LATREILLE, Nouv. Dict. Hist. Nat., 2 Ed., XVII, 1816, p. 141, ♂; SCHUCKARD, Ann. Nat. Hist., V, 1840, p. 199, No. 3, ♂; WESTWOOD, Arcan. Entom., I, 2, 1842, No. 4, ♂; *Labidus latreillei* MAYR, Wien. ent. Zeit., V, 1886, p. 33, ☿.

Labidus jurinei SHUCKARD, Ann. Nat. Hist., V, 1840, p. 198, No. 2, ♂.

Labidus jurinei WESTWOOD, Arcan. Entom., I, 2, 1842, p. 75, No. 3, ♂.

Mutilla fulvescens BLANCHARD, Cuvier, Régn. Animal, 3 Ed., Insect., II, 1849, t. 118, f. 2, ♂.

Labidus sayi HALDEMAN, Stansbury's Explor. Utah, 1852, p. 367, t. IX, f. 1–3, ♂.

Labidus pilosus F. SMITH, Catalog. Hymén. Brit. Mus., 1859, p. 7, No. 9, ♂.

Labidus atriceps F. SMITH, Catalog. Hymén. Brit. Mus., VII, 1859, p. 5, No. 6, ♂.

Eciton vastator F. SMITH, Journ. Ent., I, 1860, p. 71, ☿.

Eciton erratica F. SMITH, Journ. Ent. Soc., I, 1860, p. 71, ☿; BATES, Natur. Amazons, II, 1863, p. 358, ☿.

Nycteresia cœca ROGER, Berl. entom. Zeitschr., 1861, p. 22, ☿.

Myrmica rubra BUCKLEY, Proc. Ent. Soc. Phila., 1866, p. 335, ☿.

Pseudodichthadia incerta ERN. ANDRÉ, Suppl. aux Fourmis, 1885, p. 8. f. 1–5; Spec. Hymén. Europ., II, 1886, p. 840, f., ♀.

Eciton cœcum MAYR, Wien. Entom. Zeit., V. 1886, p. 119, ☿; Verh. zool. bot. Ges. Wien, XXXVI, 1886, p. 440, ☿. FOREL, Biol. Centr. Am., Hymén., III, 1899–1900, pp. 25, 26, 160, ☿ ♀; EMERY, Mem. R. Accad. Sci. Ist. Bologna, 1900, p. 9, ♂ ☿; WHEELER, Amer. Natur., XXXV, 1901, pp. 158, 159, ☿ ♂ ♀.

Eciton jurinei MAYR, Wien. Ent. Zeit., V, 1886, p. 33, ♂.

Labidus sayi CRESSON, Trans. Amer. Ent. Soc., Suppl., Vol., 1887, p. 259.

Labidus servillei EMERY, Bull. Soc. Ent. Ital., XXII, 1890, p. 39, ♂.

Eciton omnivorum EMERY, Bull. Soc. Ent. Ital., XXIII, 1891, p. 163, ☿; *ibid.*, XXVI, 1894, p. 179, t. ii, f. 9a–d; Zool. Jahrb., Abth. f. Syst., VIII, 1894, p. 258, ♀.

Eciton smithii DALLA TORRE, Wien. Ent. Zeit., XI, 1892, p. 89; Catalog. Hymenopt., VII, 1893, p. 6, ♂.

Eciton latreillei var. *sayi* DALLA TORRE, Catalog. Hymen., VII, 1893, p. 4, ♂.

Texas: Austin, Fort Davis (Wheeler); Hockley; Meridian (W. H. Long); Barksdale (Brown) Dallas (Boll).

Utah: Fort Gates (Haldeman).

Mexico: Nautla, Vera Cruz (C. H. T. Townsend).

The above extensive synonymy is attributable to the wide geographical distribution and common occurrence of this species, which extends from

Texas to Argentina, and the extraordinary polymorphism of the genus, the three phases having been assigned to as many genera even by the same authors. As many other Ecitons are known only from male or worker specimens their synonymy will probably undergo great changes when all the sexual forms are known. But it will be a very long time before we are in possession of this knowledge, owing to the extremely recondite habits of these ants. The males of *E. cæcum* are common about the electric lights at Austin from the latter part of March to late in April. The workers are subterranean, or hypogæic and forage in galleries just beneath the surface of the ground or under large stones. They feed not only on all sorts of insects but even on carrion (dead dogs, cats, etc.). They may be caught in traps baited with kernels of walnuts and pecans, of which they seem to be very fond. *E. omnivorum* would therefore be a very appropriate name for this species, although it is not certain that it is really the species thus designated by Olivier.

15. **Eciton esenbecki** (*Westwood*).

(Pl. XXVI, Figs. 1 and 2.)

Labidus esenbecki Westwood, Arcan. Ent., I, 1845, pp. 75, 76, pl. 20, fig. 4, ♂.

Eciton esenbecki Mayr, Wien. Ent. Zeitr., V, 1886, p. 33, ♂; Dalla Torre, Catalog. Hymenopt., VII, 1893, p. 2, ♂; Forel, Biol. Centr. Am., Hymenopt., III, 1899–1900, p. 25, ♂; Emery, Mem. Real. Accad. Ist. Bologna, 1900, pp. 7–16, ♂.

Male. Length: 15 mm.

Head, including the eyes, twice as broad as long, prolonged and suddenly constricted behind the very prominent eyes and ocelli and then broadening out with rounded posterior corners. Frontal carinæ not reaching to the anterior ocellus, converging behind and terminating abruptly without curving outward. Distance between eye and posterior ocellus a little greater than the distance between the posterior ocelli. Mandibles very long, gradually tapering to slender, pointed tips, straight at the base and tip and slightly compressed, but bent somewhat angularly at the middle. Clypeus unarmed, with straight anterior border. Antennal scapes somewhat longer than joints 1–4 of the funiculus; funiculus tapering towards the tip. Thorax robust, through the wing insertions a little broader than the head through the eyes. Scutellum without a median sulcus. Meta- and epinotum each with a median depression, the latter also with angular sides. Petiole more than twice as broad as long, with elevated border and dorso-median depression; anterior corners rounded; posterior corners more acute. Gaster cylindrical, with deflected tip and prominent genitalia; subgenital plate bifurcate, with pointed tips; lateral plates broader and more rounded. Legs slender; anterior pair small, middle and hind pairs much longer; middle metatarsus more than half as long as the tibia; claws toothed.

Opaque; finely granular; head, thorax and legs covered with sparse piligerous punctures. Tips of mandibles, genitalia and posterior edges of gastric segments smooth and shining.

Hairs and pubescence fulvous, the latter confined to the gaster and antennal funiculi, the former long and erect on all parts of the body, including the antennal scapes. In addition to these hairs there is a pair of prominent tufts of very long hairs on the epinotum, petiole and first gastric segment. On the succeeding segments the hairs are arranged in four tufts, two on each side. On the terminal segments the hairs are more abundant and their arrangement in definite tufts is less apparent. Venter with shorter and more curved hairs.

Ferruginous throughout; wings yellowish hyaline, with yellow veins and stigma.

A single specimen taken by C. Schaeffer at Las Borragas, near Brownsville, Texas, during June (Brooklyn Museum). It is probable that this is the male of *Eciton crassicorne* F. Smith, the worker form of which is not uncommon in Mexico.

16. **Eciton (Acamatus) schmitti** *Emery.*

(Pl. XXVI, Fig. 13.)

Eciton schmitti Emery, Zool. Jahrb., Abth. f. Syst., VIII, 1894, pp. 258, 259, ☿; Bull. Soc. Ent. Ital., XXVI, p. 183, ☿; Wheeler, Amer. Natur., XXXV, 1901, pp. 161–163, f. I, ♂.

Eciton sumichrasti Wheeler, Amer. Natur., XXXIV, 1900, pp. 563–574, f. 1–3, ☿ ♀.

Eciton (*Acamatus*) *schmitti* Emery, Mem. Real. Accad. Sci. Ist. Bologna, 1900, p. 16.

Texas: Austin, McNeil, Del Rio and Fort Davis (Wheeler); Meridian and Denton (W. H. Long); Paris (Miss Augusta Rucker).

New Mexico: Clayton and Las Vegas (Wheeler).

Colorado: Salida and Colorado Springs (Wheeler).

Missouri: Doniphan (P. J. Schmitt); Columbia (A. M. Ferguson).

North Carolina: Black Mountains (Wm. Beutenmüller).

Next to *E. cæcum* this is the commonest and most widely distributed species of *Eciton* in the United States. Like many of the smaller species of the genus it is fond of kidnapping the brood of other ants. For an account of its habits see my papers in the American Naturalist (1900–1901).

17. **Eciton (Acamatus) sumichrasti** *Norton.*

Eciton sumichrasti Dalla Torre, Catalog. Hymen., VII, 1893, p. 6, ☿; Emery, Zool. Jahrb., Abth. f. Syst., VIII, 1894, p. 259, ☿; Bull. Soc. Ent. Ital., XXVIII, 1896, p. 47, ☿; Forel, Biol. Centr. Am., Hymenopt., III, 1899–1900, p. 27, ☿.

Eciton (*Acamatus*) *sumichrasti* Emery, Mem. Real. Accad. Sci. Ist. Bologna 1900, p. 16.

This species, which differs from the preceding in having the cheeks of the worker more deeply pitted or foveolate, is recorded by Mayr from Texas, but I have never been able to find it in that state. What I took to be *sumichrasti*, when I first began to study ants, was *schmitti*. The former species is, however, very common in Mexico. I have taken it at Cuernavaca, Morelos and have received specimens from Tapotlan, Jalisco (C. H. T. Townsend) and Guadalajara, (J. F. McClendon). Its habits appear to be very similar to those of *E. schmitti.*

18. **Eciton (Acamatus) californicum** *Mayr.*

Eciton californicum DALLA TORRE, Catalog. Hymen., VII, 1893, p. 2, ☿; EMERY, Zool. Jahrb., Abth. f. Syst., VIII, 1894, p. 259, ☿; Bull. Soc. Ent. Ital., XXVIII, 1896, p. 48, ☿.

Eciton (Acamatus) californicum EMERY, Mem. Real. Acc. Sci. Ist. Bologna, 1900, p. 16.

Several workers taken at Las Vegas and Romeroville by T. D. A. Cockerell appear to belong to this species. They agree very closely with a series of specimens collected at Palo Alto, California by Dr. Harold Heath.

19. **Eciton (Acamatus) opacithorax** *Emery.*

(Pl. XXVI, Fig. 4.)

Eciton californicum MAYR; subsp. *opacithorax* EMERY, Zool. Jahrb., Abth. f. Syst., VIII, 1894, p. 259, ☿; Bull. Soc. Ital., XXVI, 1894, p. 184, ☿; Forel, Biol. Centr. Am., Hymen., III, 1899–1900, p. 28, ☿.

Eciton (Acamatus) opacithorax EMERY, Mem. Real. Accad. Ist. Bologna, 1900, p. 15, 16, ☿.

Eciton opacithorax, WHEELER, Amer. Natur., XXXV, 1901, p. 163–165, f. 2 e and 3, ♀ ♂.

The types of this species are from Doniphan, Missouri. I possess specimens also from Belmont, North Carolina (P. J. Schmitt), Austin, Texas and the Las Cruces Mountains, California (H. Heath). A female specimen which I took in a nest at Austin differs from the female of *E. schmitti* in the following particulars: The eyes are much smaller and distinctly concave, the posterior corners of the head and lateral borders of the pronotum are rounder, the head and thorax more shining and covered uniformly with coarse punctures. The color is somewhat paler. Length 12 mm.

The habits of this species, so far as I have been able to observe, are similar to those of *E. schmitti*, but it is much less abundant.

20. **Eciton (Acamatus) wheeleri** *Emery.*

Emery, Bull. Soc. Ital., XXXIII, 1901, pp. 55, 56, f. 8, ☿.

Worker. Length: 2.3–4 mm.

Head somewhat longer than broad, with arcuate sides and projecting posterior angles in the form of somewhat outwardly curved teeth. Eyes very distinct. Frontal carinæ curving around the antennal insertions and in front of these forming a pair of pellucid projections. Mandibles narrow, with oblique and indistinctly denticulate masticatory border. Antennal scapes reaching to the eyes, basal funicular joints a little broader than long, the penultimate joints a little longer than broad. Thorax elongate, with a faint, saddle-shaped depression between the meso- and epinotum, the latter about half as long as the promesonotum. Pronotum with a transverse carina in front, epinotum rounded behind. Petiole a little longer than broad, unarmed beneath. Postpetiole a little broader than the petiole, broader than long.

Head with numerous coarse piligerous punctures on the sides, but smooth for the most part. Thorax opaque, entirely rugose-reticulate, with scattered piligerous punctures, sides of the pronotum and mesothoracic dorsum somewhat shining, prothoracic dorsum somewhat more opaque. Petiole somewhat less opaque than the epinotum; postpetiole faintly shining, distinctly reticulate, with less pronounced piligerous punctures than the petiole and epinotum. Gaster shining. Claws simple.

Hairs long and abundant, erect or suberect, both on the body and appendages.

Rich ferruginous red; thorax and pedicel somewhat darker; gaster and legs paler.

Types from Hays County, Texas. This species occurs also in the adjacent county of Travis, at Austin, and I have received specimens from Guadalajara, Mexico (J. F. McClendon). It is closely related to *E. opacithorax* but differs in the more robust petiole and the peculiar, slightly diverging teeth into which the corners of the head are prolonged.

21. **Eciton (Acamatus) pilosum** *F. Smith.*

Eciton pilosum Dalla Torre, Catalog. Hymen., VII, 1893, p. 5, ☿; Emery, Bull. Soc. Ent. Ital., XXVI, 1894, p. 183, ☿; Forel, Biol. Centr. Am., Hymenopt., III, 1899–1900, p. 27, ☿; Emery, Mem. Real. Accad. Ist. Bologna, 1900, p. 16, ☿; Wheeler, Amer. Natur., XXXV, 1901, p. 165, ☿.

This species occurs as far north as Austin and New Braunfels, Texas, and extends southward through Mexico and Central America into Brazil.

22. **Eciton (Acamatus) pauxillum** *Wheeler.*

Wheeler, Psyche, June, 1903, pp. 93, 91, f. I, ☿.

A diminutive species of which I have seen only two small colonies, one at Austin, Texas and one in the Paisano Pass near Alpine Texas. It is related to *E. nitens* Mayr and *commutatum* Emery.

23. **Eciton (Acamatus) commutatum** *Emery.*

Eciton nitens Mayr, Sitzb. Akad. Wiss. Wien, LXI, 1870. p. 398, ☿; Wien. Ent. Zeit., V, 1886, p. 121, No. 14, ☿; Pergande, Proc. Calif. Acad. Sci. (2), V, p. 874.

Eciton (*Acamatus*) *commutatum* Emery, Mem. Real. Accad. Ist. Bologna, 1900, p. 14, ☿.

Five workers, collected by Mr. A. L. Melander at Austin, Texas, agree with the descriptions of this species, which is closely allied to, but not identical with, the true *nitens* described by Mayr in 1868 (Annu. Soc. Natural. Modena III, p. 168, No. 9). According to Emery, "the funiculus of the antennæ in *commutatum* is more club-shaped and more thickened at the tip compared with the base, and the terminal joints are shorter than in *nitens*. The postpetiole is a little broader and decidedly shorter than the petiole, whereas in *nitens* it is but little shorter and much more distinctly broader than the petiole."

24. **Eciton (Acamatus) harrisi** (*Haldeman*).

(Pl. XXVI, Fig. 10.)

Labidus harrisii Haldeman, Stansbury's Explor. Utah, 1852, p. 367, ♂; Cresson, Trans. Am. Ent. Soc., 1872, p. 194, ♂.

Eciton harrisi Dalla Torre, Catalog. Hymenopt., VII, 1893, p. 3, ♂; Emery, Zool. Jahrb., Abth. f. Syst., VIII, 1894, p. 261, ♂; Forel, Biol. Centr. Am., Hymenopt., III, 1899–1900, p. 28, ♂; Wheeler, Amer. Natur., XXXV, 1901, p. 165, f. 2a, ♂.

Eciton (*Acamatus*) *harrisi* Emery, Mem. Real. Accad. Ist. Bologna, 1900, pp. 7, 17, f. 18, ♂.

Utah: Fort Gates (Haldeman).

Texas: Austin, July 27, July 4 and Aug. 1 (Wheeler); Waco (Wm. Prather); Brownsville (C. Schaeffer); Dallas (Boll).

New Mexico: Mesilla (T. D. A. Cockerell).

Arizona: Palmerlee, Cochise County (C. Schaeffer); Nogales, June 22 (Oslar).

Mexico: Sinaloa (J. H. Batty).

This species, which may prove to be the male of *E. pilosum*, is easily distinguished by its short, straight mandibles with straight inner and convex outer borders.

25. **Eciton (Acamatus) mexicanum** (*F. Smith*).

(Pl. XXVI, Fig. 11.)

Labidus mexicanus F. Smith, Catalog. Hymen. Brit. Mus., VII, 1859, p. 7, No, 10, ♂; Cresson, Trans. Am. Ent. Soc., 1872, p. 194.

Eciton (*Labidus*) *subsulcatum* Mayr, Verh. zool. bot. Ges. Wien, XXXVI, 1886, p. 440, ♂.

Labidus subsulcatum Cresson, Trans. Amer. Ent. Soc., Suppl. Vol., 1887, p. 259.

Eciton mexicanum Dalla Torre, Catalog. Hymen., VII, 1893, p. 4, ♂; Emery, Zool. Jahrb., Abth. f. Syst., VIII, 1894, p. 260, ♂; Forel, Biol. Centr. Am., Hymenopt., III, 1899–1900, p. 27, ♂; Wheeler, Amer. Natur., XXXV, 1901, p. 165.

Eciton (*Acamatus*) *mexicanum* Emery, Mem. Real. Accad. Ist. Bologna, 1900, p. 17, f. 19, ♂.

Texas: (Belfrage); Austin, July 4 (Miss M. Holliday); Dallas (Boll).
Arizona: Nogales, July 18 (Oslar).
Mexico.

The male of this species is easily distinguished from all the known males of the genus by the peculiar shape of the mandibles which are narrow, straight at the base and curved at the tips, with the middle of the external margin concave and a low but distinct projection on the inner margin.

26. **Eciton (Acamatus) arizonense** sp. nov.

(Pl. XXVI, Fig. 5.)

Male. Length: 12–13 mm.

Head, including the eyes, twice as broad as long, not prolonged behind the eyes and ocelli, which are very large and prominent. Lateral ocellus only about ½ its diameter from the eye; median ocellus situated far back and almost between the lateral ocelli. Clypeus unarmed, with straight anterior border. Frontal carinæ separated by a deep depression, very prominent, continued back to near the anterior ocellus and curving round the antennal insertions. Mandibles falcate, about twice as long as the eyes, straight at the base but thence uniformly curving and tapering to a slender point. Antennal scape robust, about as long as joints 1–4 of the long and gradually tapering funiculus. Thorax short and robust, about twice as long as high. Scutellum without a longitudinal furrow. Epinotum rounded above, concave below. Petiole more than half as long as broad, depressed in the middle in front, with rounded posterior angles. Gaster long and cylindrical, with small genitalia; subgenital plate with a shorter, more obtuse median and two longer, more acute lateral teeth; outer appendages not spreading. Legs feeble; middle metatarsus about half as long as the tibia; claws toothed.

Head smooth and shining; remainder of the body somewhat more opaque.

Mandibles and antennal scapes very finely punctate. Thorax and gaster very finely and delicately shagreened, except the posterior edges of the segments which are smooth and shining.

Body and appendages covered with rather silky, pale yellow, appressed pile, which is longest and least appressed on the epinotum and petiole.

Rich reddish brown. Wings yellowish hyaline, with yellow veins and stigma.

Texas: Brownsville (C. Schaeffer); Austin, June 27 (Miss Holliday).

New Mexico: Las Cruces (T. D. A. Cockerell).

Arizona: Nogales, June 31, July 15 (E. J. Oslar).

In general appearance this species very closely resembles *E. mexicanum* F. Sm., but may be at once distinguished by its long sickle-shaped mandibles and longer pile, especially on the posterior portion of the thorax and petiole, dentate claws and less projecting pronotum. In *mexicanum* the subgenital plate is bidentate. In this and many other respects *E. arizonense* resembles *E. spoliator* Forel but it differs in its greater size and larger eyes, in not having the head coarsely and deeply punctured, etc.

27. **Eciton (Acamatus) oslari** sp. nov.

(Pl. XXVI, Fig. 8.)

Male. Length: 11 mm.

Head distinctly less than twice as broad as long, projecting and much rounded behind the large eyes. Ocelli large and prominent, the lateral ones less than their diameter from the eyes. Clypeus unarmed, with a broadly excised anterior border. Frontal carinæ prominent, separated by a deep groove and continued around the antennal insertions posteriorly. Mandibles narrow and rather long, falcate, bent from their very bases, and uniformly tapering to a sharp point. Antennæ long, scape but little thicker than the funiculus and hardly longer than its three basal joints; funiculus of nearly uniform breadth throughout. Thorax nearly twice as long as high. Pronotum with a marked concavity on its anterior surface, so that the mesonotum overarches the head very prominently. Scutellum rounded behind, without a median furrow. Metanotum rounded, epinotum rectangular in profile, with its horizontal basal surface only half as long as its perpendicular declivity. Petiole 1½ times as broad as long, rectangular, with straight, parallel sides and straight posterior margin; its upper surface very convex. Gaster long and cylindrical, with connate lateral valves and small bifurcate subgenital plate. Legs small and feeble; metatarsus of median pair half as long as the tibia. Claws minutely toothed.

Head and mandibles shining, sharply and sparsely punctate. Thorax, petiole and legs subopaque, finely and rather indistinctly punctate.

Pile yellowish gray, appressed, short but rather dense on the thorax, petiole and gaster, somewhat longer and more erect on the antennal scapes, mandibles, mesopleuræ, legs and venter.

Posterior half of head, upper surface of mesonotum and scutellum, black, remainder of body including the appendages reddish brown. Wings gray, with yellowish brown veins and prominent dark brown stigma.

Described from a single specimen collected by E. J. Oslar at Nogales, Arizona, July 15, 1903 (Cornell Univ. Coll., Lot, 256).

This species resembles *arizonense* but differs in the color of the body and wings, the narrower thorax and gaster, smaller mandibles, greater development of the head behind the eyes, smaller ocelli, less prominent frontal carinæ, and more slender antennæ. In color and form it is even more closely related to *E. harrisi*, but the mandibles have a very different shape, the frontal carinæ are not continued so far postero-laterally, and the petiole is larger.

28. **Eciton (Acamatus) spoliator** *Forel.*

(Pl. XXVI, Fig. 12.)

Eciton spoliator Forel, Biol. Centr. Am., Hymen., III, 1899–1900, p. 29, ♂.
Eciton (*Acamatus*) *spoliator* Emery, Mem. Real. Accad. Ist. Bologna, 1900, p. 17, ♂.

"*Male.* Length: 8.5 mm.

With the appearance of *E. melsheimeri*, but the mandibles are much larger and the head has a different form. Mandibles long, arcuate and shining, when their tips touch each other enclosing a space which is longer than the head and forms about ¾ of a circle. They are smooth, shining and punctate, very narrow and pointed at their tips. Labrum deeply bifid. Frontal carinæ rather far apart, diverging in the form of welts, separating the ocelli from the antennary fossæ, prolonged backward and disappearing towards the eyes. These are rather small, not occupying altogether ⅔ of the side of the head. Head transversely rectangular, 1½ times as broad as long. Its posterior border is feebly and broadly concave, with rounded, but very distinct posterior angles. Eyes oval. Mesonotum elongate elliptical, somewhat fusiform, broadened in the middle, narrowed in front and behind. Epinotum with a short horizontal base and a subvertical declivity. Petiole, seen from above, rectangular, transverse, with straight, parallel, lateral borders, the posterior border broadly but feebly concave, posterior angles prominent, anterior angles rounded and the anterior border excised in the middle. Seen from the side it shows a strong transverso-median convexity, with the surface sloping anteriorly and posteriorly, slightly transverse and concave towards the base. There is a feeble constriction behind each gastric segment. Hypopygium with two long and very acute lateral points and a short acute median point which is not present in *E. melsheimeri.* The antennal scapes reach to the lateral ocelli. Antennæ and legs of moderate length.

Shining, with deep, coarse and scattered punctures on the head and thorax, finer and more abundant punctures on the petiole and gaster.

Hairs long, abundant and yellow, on the under side of the petiole, on the tip of the gaster and mandibles. Remainder of body, legs and scapes covered with yellow oblique pubescence, which is very abundant on the gaster, sparse on the thorax and especially on the head, passing here and there into the pilosity. On the borders of the petiole there is a brush of rather straight, short hairs.

Entirely yellowish red, with the head, excepting the mandibles and antennæ, black. Wings hairy, smoky brown, with brown veins and stigma.

Costa Rica (Alfaro)" (Forel).

Two specimens labeled "Texas (Belfrage)," received from Dr. W. H. Ashmead under the name of "*Acamatus fuscipennis* Cresson," agree so closely with the above description that I do not hesitate to assign them to Forel's species.

29. **Eciton (Acamatus) nigrescens** (*Cresson*).

(Pl. XXVI, Fig. 7.)

Labidus nigrescens Cresson, Trans. Am. Ent. Soc., IV, 1872, p. 194, ♂.
Eciton nigrescens Mayr, Wien. Ent. Zeit., V, 1886, p. 33 ♂; Emery, Zool. Jahrb., Abth. f. Syst., VIII, 1894, p. 261.

Male. Length: 10 mm.

Head, including the eyes, less than twice as broad as long, convex above, without posterior angles behind. Frontal carinæ obtuse, curving outward behind but fading into the swollen sides of the front before reaching the eyes. Clypeal border straight, unarmed. Eyes small, but protruding. Ocelli small, the lateral pair separated from the eyes by a distance nearly equal to the length of the latter. Mandibles very broad, flat, with convex external and internal borders, curved only at their narrow bases, with acute, suddenly tapering tips. Antennæ long and robust; scape shorter than joints 1–3 of the funiculus; first funicular joint much shorter than long, remaining joints gradually tapering distally. Thorax robust, mesonotum with a prominent, median, longitudinal ridge which runs into a slight depression at the anterior end. Scutellum and metanotum without median depressions. Epinotum with short base, long, abrupt and flattened declivity and rounded, bulging sides. Petiole 2½ times as broad as long, a little broader behind than in front, with rounded anterior corners and nearly rectangular, moderately acute posterior corners. Its upper surface seen from the front is slightly convex in the middle and slightly concave anteriorly and on each side behind; the margins are not reflected. Gaster rather slender, with faint but distinct constrictions between the segments. Hypopygium with two acute lateral teeth and no median tooth. Middle metatarsus more than half as long as the tibia. Claws with minute teeth.

Somewhat shining; mandibles, head and thorax coarsely punctate, the thorax more densely; gaster still more finely and densely punctate.

Hairs dull yellowish, not abundant; long on the head and sides of the thorax, considerably shorter and more appressed on the gaster and legs. Eyes distinctly hairy.

Black; antennæ, tips of mandibles, articulations of legs, tarsi, posterior margins of gastric segments, hypopygium and insertions of wings, dark red. Wings dusky hyaline, with dark brown stigma and somewhat lighter veins.

The type of this species, from Texas, is in the Museum of the Philadelphia Academy of Sciences. I have redescribed it from a Kansas specimen in the United States National Museum. This specimen agrees very closely with Cresson's description except that the wings are paler, and possibly faded with age. It is closely allied to *E. schmitti* and *E. opacithorax* in having very small eyes, but it differs from both of these species in the color of the gaster. From *opacithorax* it differs also in the shorter and more robust thorax, thicker antennæ, and in having broader mandibles, with convex instead of straight external border. From *schmitti* it differs in having the head more convex behind the eyes, in the presence of a distinct mesonotal ridge, two instead of three teeth on the hypopygium, in the smaller size, much paler wings and sparser hair. *E. nigrescens* is also allied to *E. harrisi,* especially in the shape of the mandibles, but is a more robust species and besides the darker color, has much smaller eyes and ocelli and a proportionally longer head.

30. **Eciton (Acamatus) melsheimeri** (*Haldeman*).

(Pl. XXVI, Fig. 9.)

Dorylus (Labidus) melshæmeri HALDEMAN, Stansbury, Explor. Salt. Lake, 1852, p. 368, ♂.

Eciton melshæmeri MAYR, Wien. Ent. Zeit., V, 1886, p. 33, ♂; DALLA TORRE, Catalog. Hymenopt., VII, 1893, p. 4, ♂; EMERY, Zool. Jahrb., Abth. f. Syst. VIII, 1894, p. 261, ♂; WHEELER, Amer. Natur., XXXV, 1901, p. 165, ♂.

Labidus melshæmeri CRESSON, Trans. Am. Ent. Soc., Suppl. Vol., 1887, p. 259.

Eciton melsheimeri FOREL, Biol. Centr. Am., Hymenopt., III, 1899–1900, p. 28, ♂.

Eciton (Acamatus) melshæmeri EMERY, Mem. Real. Accad. Ist. Bologna, 1900, p. 17, ♂.

Utah: Fort Gates (Haldeman).

Texas: Austin (Wheeler, Miss Holliday); Brownsville (C. Shaeffer); Plano (E. S. Tucker); Dallas (Boll).

Mexico: Paso de Telaya, Vera Cruz (C. H. T. Townsend).

This species is common at Austin about electric lights during the spring and summer months. It ranges as far south as Guatemala and Costa Rica.

31. **Eciton (Acamatus) minus** (*Cresson*).

(Pl. XXVI, Fig. 6.)

Labidus minor CRESSON, Trans. Am. Ent. Soc., IV, 1872, p. 195, ♂.

Eciton minor MAYR, Verh. zool. bot. Ges. Wien., XXXVI, 1886, p. 441, ♂.

Labidus minor CRESSON, Trans. Am. Ent. Soc., Suppl. Vol., 1887, p. 259, ♂.

Eciton minus DALLA TORRE, Catalog. Hymen., VII, 1893, p. 4, ♂; EMERY, Zool. Jahrb., Abth. f. Syst., VIII, 1894, p. 261, ♂; FOREL, Biol. Centr. Am., Hymenopt., III, 1899–1900, p. 29, ♂; EMERY, Mem. Real. Accad. Ist. Bologna, 1900, p. 17, ♂; WHEELER, Amer. Natur., XXXV, 1901, p. 165, ♂.

This small species seems to be much less abundant than the preceding. I have seen specimens from Texas collected by Belfrage but I have not taken it at Austin.

Subfamily MYRMICINÆ.

32. **Pseudomyrma flavidula** *F. Smith.*

Pseudomyrma flavidula F. SMITH, Catal. Hymen. Brit. Mus., VI, 1858, p. 157, No. 15, ☿; NORTON, Amer. Natur., II, 1868, p. 65, ☿; MAYR, Sitzb. Akad. Wiss. Wein, LXI, 1870, p. 408; EMERY, Bull. Soc. Ent. Ital., XXII, 1890, p. 79, t. 6, f. 4, ☿; DALLA TORRE, Catalog. Hymenopt., VII, 1893, p. 57; EMERY, Zool. Jahrb., Abth. f. Syst., VIII, 1894, p. 269, ☿; Boll. Mus. Zool. Anat. Comp. Torino, XI, 1896, p. 2 (extr.), ☿; FOREL, Trans. Ent. Soc. London, 1897, p. 300, ☿; Biol. Centr. Am., Hymenopt., III, 1899–1900, pp. 92, 93, ☿; Ann. Soc. Ent. Belg., XLIX, 1905, p. 158, ☿; WHEELER, Bull. Am. Mus. Nat. Hist., XXI, 1905, pp. 83–85, ☿ ♀ ♂.

Texas: Barksdale (Brown); New Braunfels and Austin (Wheeler).

This species, which is easily distinguished from *P. pallida* by the two black spots at the base of the gaster, is common throughout tropical America (West Indies, Florida, Central and South America). It nests in hollow stems, preferring in Texas the twigs of the hop-tree (*Ptelea trifoliata*). The northernmost limit of its range must be reached near Austin, where it is not at all common. The Texan specimens agree in all respects with specimens in my collection from Miami, Florida, Bahamas and Atoyac, Guadalajara and Colima in Mexico.

33. **Pseudomyrma pallida** *F. Smith.*

Pseudomyrma pallida F. SMITH, Trans. Ent. Soc. London (2), III, 1855, p. 159, No. 9, ☿; Catalog. Hymen. Brit. Mus., VI, 1858, p. 159, No. 21, ☿; DALLA TORRE, Catalog. Hymen., VI, 1893, p. 58, ☿; EMERY, Zool. Jahrb., Abth. f. Syst., VIII, 1894, p. 269, ☿; FOREL, Biol. Centr. Am., Hymen., III, 1899–1900, p. 92; EMERY, Bull. Soc. Ent. Ital., XXXVII, 1905, p. 119, ☿; FOREL, Ann. Soc. Ent. Belg., L, 1906, p. 231.

Worker. Length: 3.5–4 mm.

Head 1⅓ times as long as broad, as broad in front as behind, with feebly but broadly excised posterior margin and slightly convex sides. Clypeus notched on each side. Eyes half as long as the side of the head, the preocular region being half as long as the postocular. Antennal scape reaching only ⅓ the distance from its insertion to the occipital border of the head; first joint of funiculus nearly as long as the three succeeding joints; joints 2–10 as broad as long, terminal joint somewhat longer. Thorax with distinct promesonotal and mesoëpinotal constrictions, metathoracic and epinotal stigmata equally prominent. Pronotum very feebly margined on the sides, mesonotum transversely elliptical, about ⅓ as long as the pronotum; epinotum about twice as long as the declivity, with which it forms a rounded obtuse angle. Petiole slender but hardly pedunculate at the base, nearly four times as long as broad, broadest behind the middle, slightly flattened above, rounded and not marginate on the sides. In profile the node is low and rounded, with gently ascending, barely concave anterior, and somewhat shorter, convex posterior slopes. Postpetiole pyriform, more than twice as broad as the petiole, as broad as long. Gaster and legs as usual, femora thickened.

Smooth and shining; mandibles, head and thorax very finely punctate, the punctures on the posterior portions of the head and lateral surface of the thorax somewhat more distinct.

Hairs yellow, erect, delicate and very sparse, mainly on the gaster and anterior parts of the head. Pubescence pale, almost imperceptible except on the gaster and petiole, where it is very short and does not obscure the shining surface.

Honey yellow; head and thorax sometimes slightly reddish; mandibular teeth, eyes and ocelli black.

Texas: Waco, New Braunfels, and Austin (Wheeler); Brownsville (C. Schaeffer).

Arizona: Huachuca Mountains (C. Schaeffer).

Mexico: Ojo del Cerro Chilicote, Chihuahua (C. H. T. Townsend).

Florida: Key West (Pergande).

The workers taken in Chihuahua are larger (5–5.5 mm.) than the Texan specimens, but it is probable that the species is depauperate in the latter locality, where it is by no means common. *P. pallida* is so similar to *flavidula* that some doubt may be entertained as to its specific rank. The two gastric spots of *flavidula* are sometimes very faint, and if entirely lacking this species would be hard to distinguish from *pallida*. Coloration is known to be highly variable in certain species of *Pseudomyrma*.

34. **Pseudomyrma brunnea** *F. Smith.*

Pseudomyrma brunnea F. Smith, Trans. Ent. Soc. London, 1877, pp. 63–64, ☿; Dalla Torre, Catalog. Hymen., VII, 1893, p. 56, ☿; Emery, Zool. Jahrb., Abth. f. Syst., VIII, 1896, p. 269, ☿; Forel, Biol. Centr. Am., Hymen., III, 1899–1900, p. 97, ☿.

Worker. Length: 2.5–3 mm.

Head nearly 1½ times as long as broad, as broad in front as behind, with straight posterior border and rounded posterior corners and slightly convex sides. Clypeus notched on each side. Eyes large, fully half as long as the head. Preocular less than half as long as the postocular border of the head. Antennal scape hardly reaching to a third of the distance between its insertion and the posterior corner of the head.

Basal funicular joint fully as long as the 3 succeeding joints taken together, joints 2–5 broader than long, succeeding joints as long as broad, terminal joint much longer than broad. Thorax with a well developed, depressed suture between the pro- and mesonotum and a deep, rather long impression between the meso- and epinotum. Mesonotum transverse, distinctly angular in front, less than ⅓ as long as the pronotum which is bluntly marginate on the sides; epinotum large and prominent, its declivity as long as the basal surface which is convex and somewhat flattened in the middle; angle between the two surfaces much rounded. Petiole distinctly pedunculate, less than four times as long as wide, in profile with a gently rising, but not convex anterior slope, low rounded node, not marginate laterally, shorter convex posterior slope and straight lower surface, with a prominent tooth near the anterior end. Post petiole pyriform a little longer than broad, with a short but distinct anterior peduncle. Legs robust; femora incrassated.

Smooth and shining, finely punctate; thorax slightly opaque.

Hairs whitish, erect, exceedingly sparse, confined to the tip of the gaster and anterior portion of the head. Pubescence extremely short and inconspicuous.

Dark brown; mandibles yellow, with black teeth; clypeus, antennæ, prothorax, petiole, tibiæ and tarsi more or less yellowish or light brown; gaster black.

Female. (deälated) Length: 4 mm.

Very similar to the worker. Head somewhat longer, with more parallel sides. Mesonotum, scutellum and postpetiole yellowish like the pronotum and petiole. Epinotum short, convex and rounded, subopaque.

Texas: New Braunfels and Waco (Wheeler); Esperanza Ranch, Brownsville (C. Schaeffer).

The types of this species are from Mexico. It is known to occur also in tropical Florida.

35. **Pseudomyrma gracilis** *Fabr.* var. **mexicana** *Roger.*

Pseudomyrma mexicana Roger, Berl. Ent. Zeitschr., VII, 1863, p. 178, No. 67, ☿.
Pseudomyrma gracilis var. *mexicana* Emery, Bull. Soc. Ent. Ital., XXII, 1890, p. 60, t. 5, f. 16, ☿; Dalla Torre, Catalog. Hymen., VII, p. 57; Forel, Biol. Centr. Am., Hymen., III, 1899–1900, p. 91.

Two workers and a winged female taken by Mr. C. Schaeffer on the Esperanza Ranch at Brownsville, Texas, may be assigned to this variety, although they are all very small, the workers measuring only 6 mm., the female 9 mm. *P. gracilis* is notoriously variable in coloration, but in this character the Brownsville specimens are very similar to the typical *mexicana.*

36. **Myrmecina graminicola americana** *Emery.*

Myrmecina latreillei subsp. *americana* Emery, Zool. Jahrb., Abth. f. Syst., VIII, 1894, p. 271, ☿; Wheeler, Bull. Am. Mus. Nat. Hist., XXI, 1905, p. 376, ☿.

A single worker measuring 2.6 mm. taken on the banks of the Comal River at New Braunfels, Texas, and a male from Plano (E. S. Tucker) agree very closely with specimens from New York and Connecticut. In the worker the epinotal spines are moderately large and have strongly upturned, rather blunt tips. The teeth at the base of the epinotum are very prominent and acute. As Emery has shown, the North American differ from the European forms of *graminicola* in lacking a distinct median keel on the clypeus and in having blunter clypeal teeth. The teeth on the base of the epinotum and the epinotal spines are highly variable in our forms, as I find from an examination of specimens from numerous nests and localities.

37. **Myrmecina graminicola americana** var. **brevispinosa** Emery.

Myrmecina latreillei subsp. *americana* var. *brevispinosa* Emery, Zool. Jahrb., Abth. f. Syst., VIII, 1894, p. 271, ☿ ♀ ♂; Wheeler, Bull. Am. Mus. Nat. Hist., XXII, 1906, p. 335, 336, ☿.

Several workers from Austin Texas and Indian Garden, Grand Cañon, Arizona have short, nearly straight, acute epinotal spines, hardly longer than broad at the base, and of a yellowish or brownish color.

38. **Myrmecina graminicola texana** subsp. nov.

Several workers collected in Shoal Creek, Austin, Texas have all but the middle and posterior portion of the first gastric segment somewhat opaque and finely granular or shagreened. The epinotal spines are nearly as long as those of the typical *americana* and sharply turned up at their rather blunt tips. The teeth on the base of the epinotum are very prominent, acute and turned forward. The clypeal teeth are blunt and rounded, the clypeal carinæ obsolete. Length, 2–2.9 mm.

39. **Monomorium pharaonis** (*L.*)

Monomorium pharaonis Dalla Torre, Catalog. Hymen., VII, 1893, p. 68, ☿ ♀ ♂; Emery, Zool. Jahrb., Abth. f. Syst., VIII, 1894, p. 275; Forel, Biol. Centr. Am. Hymen., III, 1899–1900, p. 78; Wheeler, Bull. Am. Mus. Nat. Hist., XXI, 1905, pp. 376, 377.

Texas: Austin and Galveston (Wheeler).

This Old World ant is rare and sporadic in houses in Texas but whether this is due to recent importation or to the difficulty of establishing itself where there are so many other species of Formicidæ, I have not been able to determine.

40. **Monomorium minutum** *Mayr.* var. **minimum** (*Buckley*).

Myrmica minima BUCKLEY, Proc. Ent. Soc. Phila., 1866, p. 338, ☿; DALLA TORRE, Catalog. Hymen., VII, 1893, p. 112, ☿ ♀.

Myrmica atra BUCKLEY, *ibid.*, p. 342, ♀.

Monomorium minutum var. *minimum* EMERY, Zool. Jahrb., Abth. f. Syst., VIII, 1894, p. 274, 275, ☿ ♀ ♂; WHEELER, Bull. Am. Mus. Nat. Hist., XXI, 1905, p. 377; *ibid.*, XXII, 1906, p. 336.

Texas: Austin and Limpio Cañon, Fort Davis (Wheeler); Paris (Miss Augusta Rucker); Plano (E. S. Tucker).

New Mexico: Las Valles, 5,900 ft. (Miss Mary Cooper); Las Vegas Hot Springs, 7,000 ft. (T. D. A. Cockerell).

Arizona: Prescott and Grand Cañon (Wheeler).

Nevada: King's Cañon, Ormsby County (C. F. Baker).

Colorado: Colorado Springs and Buena Vista (Wheeler).

Mexico: Guadalajara (J. F. McClendon).

This tiny black species is easily distinguished from the closely allied *M. carbonarium* F. Smith by the shape of the epinotum and petiole. In *minimum* the epinotum is rounded, without a distinct angle between the basal surface and declivity, and the petiole is only slightly compressed antero-posteriorly, whereas in *carbonarium* and its subspecies *ebeninum* Forel the epinotum is somewhat cuboidal and is distinctly angular in profile, and the petiole is strongly compressed anteroposteriorly, with the upper border of the node transverse and even slightly concave in the middle. The females of the typical *minimum* are always winged, so far as I have observed, whereas the subspecies *ergatogyna* Wheeler from Catalina and California and *C. carbonarium* have ergatomorphic females. Moreover, according to my observations, *M. minutum* always nests in the ground in small crater nests or under stones, whereas *carbonarium* nests in twigs, Tillandsias and other vegetable cavities.

41. **Erebomyrma longi** *Wheeler.*

Erebomyrma longi WHEELER, Biol. Bull., IV, 1903, pp. 140–144, ☿ ♀ ♂.

Texas: Denton (W. H. Long).

This singular species is probably cleptobiotic in the nests of termites. Emery has recently described a second species of the genus (*E. peruviana*) from Marcapata, Peru. (Bull. Soc. Ent. Ital. XXXVII, 1905, p. 139 *nota.*)

42. **Solenopsis geminata** (*Fabricius*).

Solenopsis geminata Dalla Torre, Catalog. Hymen., VII, 1893, p. 76, 77; Emery, Zool. Jahrb., Abth. f. Syst., VIII, 1894, pp. 276, 277; Forel, Biol. Centr. Am., Hymen., III, 1899–1900, pp. 79, 80; Fenner, Ent. News, VI, 1895, p. 216.
Solenopsis xyloni McCook, Comstock's Rep. on Cotton Insects, 1879, p. 188, f. 37, 38.

Texas: Austin, New Braunfels, Fort Davis (Wheeler).

Arizona: Phoenix (Wheeler); Tucson (Fenner).

According to Forel: the American form of this well-known tropicopolitan "fire-ant" or "hormiga brava" is black or brownish, with the head of the worker maxima reddish. "This is the form described by Fabricius. The form of tropical Asia (*S. geminata* F. r. *rufa* Jerdon) is a different race [subspecies], which has between the mesosternum and the prosternum on each side, a tooth directed downward and backward. The node of the petiole is also thicker, and the color is always a reddish yellow or orange, with only the posterior half of the gaster brown. This race alone is cosmopolitan and has been transported to the Antilles (and to Mexico, Durango) while the true (dark colored) *geminata* is confined to tropical America."

Among the American forms two subspecies have been distinguished, *gayi* Spinola of Chile and *pylades* Forel of Mexico. The latter is based on a female specimen and probably represents a very distinct species near *S. mœlleri* of Brazil. After examining a great number of nests of this abundant ant in the southwestern states, Mexico and the West Indies I have concluded that at least three distinctly marked varieties should be recognized in these regions. One is the typical dark form and seems to have been the one which McCook called *xyloni*. His description is exceedingly brief and the female which he says is "uniform amber color" must have been immature. This typical form is the most abundant and widely distributed, making its nests in open, sunny places, by preference in dark or black soil. The nests are straggling, irregular craters with several, often confluent openings. The ants store seeds and are at the same time highly carnivorous. The worker maxima of this form does not exceed 5 mm.; the female measures 6–7 mm., the male 5–5.3 mm. The worker is dark brown or even black, with the whole head or often only its anterior portion, the legs, antennæ, and articulations of the petiole, red or yellow. The male is black with yellow mandibles, antennæ, legs and thoracic sutures and a dark median and two parapsidal spots on the thorax.

43. **Solenopsis geminata** var. **diabola** var. nov.

Texas: Montopolis, Austin, Lampasas, Langtry (Wheeler); Paris

(Miss Augusta Rucker); Dallas (W. D. Hunter); Granite Mountain (W. H. Long); Plano (E. S. Tucker).

Arizona: Tempe (Wheeler).

California: Needles (Wheeler).

This variety resembles the oriental subspecies *rufa* in color, but there is no mesosternal spine. The worker maxima is 6.5–7.5 mm. in length, the female 7–8 mm., the male 5.5–6 mm. The worker is a rich orange red with the mandibles and more or less of the posterior portion of the gaster black. In the female each gastric segment has a broad, dark brown band across its posterior portion, and there are anteromedian and parapsidal brown blotches on the thorax. The male is black, with a dark brown thorax and pale yellow thoracic sutures, mandibles, antennæ and legs. The scutellum and metanotum are much darker than the remainder of the thorax. In both the female and worker the scattered punctures on the head are much smaller than in the typical *geminata*. The types are from Montopolis near Austin, Texas. It seems to occur only in sand, or in very sandy soil especially on the banks of rivers and creeks. The specimens taken at Needles, California, and Tempe, Arizona, in the sands on the banks of the Gila and Colorado Rivers, are smaller and paler in coloration (maxima 3.5–4 mm.; female 6.5–7 mm.; male 5 mm.) and form a transition to the following variety:

44. **Solenopsis geminata** var. **aurea** *Wheeler.*

Wheeler, Bull. Mus. Nat. Hist., XXII, 1906, p. 336, ☿ ♀ ♂.

Texas: Austin, Fort Davis, Terlingua (Wheeler); Huntsville (Miss Anna Pritchett).

New Mexico: Alamogordo (H. Viereck).

Arizona: Grand Cañon, Yucca (Wheeler).

Mexico: Guadalajara (J. F. McClendon).

This variety is decidedly smaller than the typical form (worker 2–3.5 mm.; female 5–5.5 mm., male 5 mm.). The worker and female are deep yellow with brown margins to the gastric segments, the head is very smooth and shining, with very small punctures. The clypeal teeth are small and acute and there is no mesosternal tooth. Thorax of male dark brown or black. A female and four workers from the mountains near Claremont, California (C. F. Baker) seem to represent a transition from this variety to the typical form. They have the whole of the gaster black. The female is very small (less than 5 mm.) and has the upper surface of the head, thorax and pedicel brown. *S. aurea* inhabits dry, stony situations and does not build open crater nests, but so far as I have observed, always lives under large stones. It appears to be nocturnal or hypogæic, unlike the typical *geminata*, which is found abroad at all hours of the days.

45. **Solenopsis pilosula** sp. nov.

(Pl. XXVI, Figs. 26 and 27.)

Worker, Length: 2–2.7 mm.

Head rectangular, distinctly longer than broad, with straight posterior margin and parallel sides. Clypeus short, broadly rounded, with four small, acute, subequal teeth, the mesial pair of which are slightly further apart than the outer and mesial tooth on each side. Mandibles with oblique, 4-toothed blades. Eyes minute, with less than 5 facets in their transverse diameter, situated ¼ the distance from the anterior to the posterior corner of the head. Antennæ slender, tip of scape reaching half way between the eye and the posterior corner of the head. Club about the same length as the remainder of the funiculus, its basal ⅓ the length of its terminal joint, remaining portion of funiculus very slender, first joint as long as the 4 succeeding joints together, joints 2–7 decidedly broader than long. Prothorax ⅔ as broad as the head, with rounded humeri and flattened dorsal surface. Epinotum half as long as the pronotum and as broad as long; in profile its basal surface is flat above and except for the pronounced mesoëpinotal suture, continuous in outline with the pro- and mesonotum; more angular on the sides, concave in the middle; declivity abrupt, hardly half as long as the basal surface. Petiolar node as broad as the epinotum, transversely elliptical from above, twice as broad as long; in profile as high as the front of the epinotum, thick and rounded, with short concave anterior slope and abrupt posterior slope, and a distinct anteroventral tooth. Postpetiole slightly narrower than the petiole, subglobular, somewhat broader than long; in profile much lower than the petiole, with small but distinct anteroventral tooth; node rounded, rising abruptly in front and more sloping behind. Gaster larger than the head, broadly excised in front, flattened dorsoventrally. Legs slender, femora but little thickened.

Smooth and shining, mandibles striato-punctate, body covered with evenly distributed punctures which are coarsest and most conspicuous on the upper surface of the head, finest on the gaster.

Body and appendages covered with fine, rather dense, erect, yellow hairs which are long on the gaster and pedicel and distinctly shorter on the other portions of the body.

Deep yellow; mandibular teeth black; border of clypeus brown; legs and antennæ somewhat paler than the body.

Male. Length: 4.25–4.5 mm.

Head small, excluding the eyes about as broad as long, cheeks very short, postocular region rounded and convex. Eyes projecting, elliptical. Clypeus with a large, rounded tubercular convexity in the middle and straight transverse anterior border. Mandibles pointed, with very oblique, obscurely dentate blades. Antennæ short; first and second joints incrassated, remaining joints slender; first joint about twice as long as the second, which is subglobular but distinctly longer than broad; joints 3 and 4, especially the latter, very slender, subequal, longer than broad, remaining joints increasing somewhat in length distally. Thorax large and robust; epinotum rounded with subequal base and declivity; the former sloping, the latter abrupt. Petiole from above a little longer than broad, with the sides bluntly angular in the middle; in profile the node is very angular, with long concave anterior and somewhat shorter and more abruptly concave posterior slope. Seen from behind the node is distinctly notched in the middle. Postpetiole much broader than the petiole and fully 1½ times as broad as long, with the sides more angular in the middle than those of the petiole.

Smooth and shining; ocellar area of head opaque, granular; regions between the antennæ and eyes finely striated. Mesonotum and scutellum coarsely and sparsely punctate. Epinotum and pedicel indistinctly punctate-rugulose. Gaster glabrous.

Pilosity white, similar to that of the worker but much sparser.

Body deep black. Mandibles and antennal scapes and venter dark piceous brown, funiculi, legs and genitalia sordid yellow, femora more or less infuscated. Wings whitish hyaline, with very pale yellow veins and stigma.

Described from several workers and males taken at Alice, Texas, July 16, while the colony was coming to the surface from a small indistinct crater, to celebrate its nuptial flight.

This species is certainly different from any of the described North American forms and I can find nothing like it among the long series of Emery's South American species of many of which I possess cotypes through the kindness of Professor Emery and Dr. Silvestri. In Emery's table the new species goes down to *S. wasmanni* but it certainly differs in its smaller size, lighter color, pilosity and sculpture and last, but not least, in having monomorphic workers.

46. **Solenopsis salina** sp. nov.

(Pl. XXVI, Figs 24 and 25.)

Worker. Length: 1.8–2 mm.

Head rectangular, distinctly longer than broad, with straight posterior border and very slightly convex, parallel sides. Clypeus short, not produced in the middle, its carinæ rather feeble, median teeth acute and turned outward, lateral teeth much broader, shorter and blunter. Mandibles with oblique 4-toothed blades. Antennæ rather long, tip of scape extending to half the distance between the eye and the posterior corner of the head; club as long as the remainder of the funiculus, of rather uniform diameter throughout, basal less than ½ as long as the terminal joint; first joint of funiculus about as long as joints 2–4; joints 2–7 slender, about as long as broad. Eyes rather small, with only 3–4 facets in their longitudinal diameter, situated fully ⅓ the distance from the anterior to the posterior corner of the head. Pro- and mesonotum about half as broad as the head, longer than broad, rather convex, mesoëpinotal suture pronounced; epinotum small and narrow above, broader and more rounded below, as long as broad, in profile rounded, without a distinct angle between the base and declivity, which are of about equal length. Petiole from above narrower than the epinotum, pedunculate in front and subglobular behind. In profile it has a thick and rounded node with a long, concave anterior slope and a pronounced anteroventral tooth. Postpetiole as broad as the petiole, globular, about as long as broad, in profile but little lower than the petiole, with slope slanting downward and backward, and a minute but distinct anteroventral tooth. Gaster a little larger than the head, with very faint excision in its anterior border. Legs moderately stout, femora but little thickened.

Smooth and shining, upper surface of head, especially in front and on the sides, with scattered rather coarse punctures; punctures on the remainder of the body very small.

Body and appendages covered with rather abundant, erect, coarse, white hairs.

Deep yellow; teeth of mandibles and anterior border of clypeus dark brown.

Described from a number of workers taken from a single colony at Fort Davis, Texas. The ants were running in a dense file on the dry ground, apparently in the act of moving to a new nest. A great many specimens of the same species were sent me by Mr. C. H. T. Townsend who took them on the Santo Domingo Ranch at the Ojos del Diablo, Chihuahua, Mexico. According to a note accompanying the specimens they were found in a nest "under a large stone in grass encrusted with the saline deposit from the water of hot springs."

S. salina resembles the preceding species but differs in its smaller size, more rounded epinotum, the shape of the clypeal teeth, porportionally larger eyes, smaller cephalic punctures and larger antennal scapes.

47. **Solenopsis krockowi** sp. nov.

(Pl. XXVI, Figs. 28 and 29.)

Worker. Length: 2.25–2.5 mm.

Head rectangular, longer than broad, with straight posterior and slightly convex lateral margins. Eyes with about 4 facets in their longitudinal diameter, situated $\frac{1}{3}$ the distance from the anterior to the posterior corners of the head. Mandibles with oblique, 4-toothed blades. Clypeus short, not projecting, with two very small, acute median teeth and shorter and less acute lateral teeth. Antennæ slender, scapes slightly thickened towards their tips which reach half way between the eyes and the posterior corners of the head. Club slender, as long as the remainder of the funiculus, its basal about half as long as its apical joint. First funicular joint as long as the three succeeding joints together; joints 2–7 slender, as long as broad. Thorax slender, prothorax a little more than half as broad as the head, about $1\frac{2}{5}$ as long as broad through its broadest portion, very round and convex in front; with pronounced mesoëpinotal constriction. Epinotum small, distinctly longer than broad, with rather flattened basal and declivous surfaces of about equal length and meeting at a rounded obtuse angle. Petiolar and postpetiolar nodes seen from above of the same breadth and of similar transversely elliptical shape, although the former is twice as broad as long, the latter nearly as long as broad. In profile the petiolar node is higher than the postpetiole, with short concave anterior slope, rounded summit and abrupt, straight posterior slope. The antero-ventral tooth is compressed and very blunt. The postpetiole in profile has its anterior surface inclined backward and downward and has a minute anteromedian tooth. Gaster larger than the head, with rather prominent anterior corners and slightly concave anterior margin. Legs rather slender.

Smooth and shining, head sparsely punctate.

Hairs yellow, erect, moderately long and abundant on the body and appendages.

Yellow throughout, with black mandibular teeth.

Female. Length: 7–7.25 mm.

Body long and slender, head, including the eyes, nearly as broad as the thorax through the wing insertions; excluding the mandibles, nearly as long as broad, somewhat narrowed anteriorly, with straight posterior border. Mandibles and clypeal teeth similar to those of the worker. Antennæ slender, scape reaching to the posterior corner of the eye; club similar to that of the worker but shorter than the remainder of the funiculus, all the joints of which are distinctly longer than broad. Thorax more than twice as long as broad, elongate elliptical, mesonotum flattened above, epinotum steep, rounded, without distinct basal and declivous surfaces. Petiole nearly 1½ times as long as broad, with a thick, transverse node, with its upper margin distinctly impressed in the middle; ventromedial tooth compressed and blunt. Postpetiole slightly broader than the petiole, with a faintly concave anterior and convex posterior surface; seen from behind it is somewhat flattened above. Gaster elongate, oblong, with straight anterior margin, somewhat flattened dorsoventrally. Wings long. The venation of the fore wing is peculiar in having the inner branch of the cubital connected with the outer branch by a distinct transverse vein and in having a small portion of the inner branch extending proximally from the transverse vein and thus representing the distal portion of a second cubital cell.

Smooth and shining, mandibles more opaque, striato-punctate. Head, thorax and gaster punctate, the first very coarsely and rather densely, the last very finely and sparsely, the thorax and scutellum with punctures of intermediate size but lacking in a broad median dorsal streak which is very glabrous. Petiole and postpetiole somewhat punctate on their upper surfaces.

Hairs yellow, erect, denser and relatively shorter on the head and thorax.

Head and thorax rich chestnut brown; mandibles, anterior portion of head and ventral portion of thorax more yellowish. Gaster deep yellow, first segment chestnut brown above with the exception of the anterior and posterior border, the succeeding segments each with a narrow transverse chestnut band near the posterior margin. Antennæ and legs deep yellow. Wings hyaline, with yellow veins and a large brown stigma.

Described from several females and numerous workers taken by Mr. Gneomar von Krockow under a stone in Box Cañon, Sacramento Mountains, New Mexico, July 6, 1906.

The worker of this species is very similar to that of *S. pilosula*, but differs in its rich yellow color, its larger eyes, smaller clypeal teeth, shorter petiolar node and smaller cephalic punctures. From *salina* it differs in its larger size, purer yellow color, and more gibbous pronotum.

48. **Solenopsis molesta** (*Say*).

Myrmica molesta Say, Bost. Soc. Journ. Nat. Hist., I, 3, 1836, p. 293, No. 6, ♀; Leconte, Writ. of Th. Say., Entomol., II, 1859, p. 737, No. 6, ♀.
Myrmica minuta Say, Bost. Soc. Journ. Nat. Hist., I, 1836, p. 294, No. 7, ☿; Smith, Catalog. Hymen. Brit. Mus., VI, 1853, p. 129, No. 61, ☿.
Myrmica exigua Buckley, Proc. Entom. Soc. Phila., 1866, p. 342, ☿ ♀.
Solenopsis debilis Mayr, Verh. zoöl. bot. Ges. Wien, XXXVI, 1886, p. 461, ☿ ♀ ♂; Dalla Torre, Catalog. Hymen., VII, 1893, p. 75, ☿.
Solenopsis molesta Emery, Zool. Jahrb., Abth. f. Syst., VIII, 1894, pp. 277, 278; Wheeler, Bull. Am. Mus. Nat. Hist., XXI, 1905, pp. 277–378.

New Mexico: Las Valles; Las Vegas (T. D. A. Cockerell).

Mayr mentions specimens of this common northern species from "Texas" as being in the Museum of Stockholm. I have never found it in southwestern or central Texas where its place is taken by *S. texana*. It probably occurs, however, in the north eastern portion of the State.

49. **Solenopsis molesta** var. **validiuscula** *Emery*.

Emery, Zool. Jahrb., Abth. f. Syst., VIII, 1894, p. 278, ☿.

According to Emery the worker of this variety differs from that of the common form of the species in the Northeastern States by its larger size, darker color and more distinct lateral teeth on the clypeus. Without an examination of the types, however, it is not easy to fix on the exact western form that should bear this name. Specimens sent me from Manzanares, by Miss Mary Cooper and from San Ignacio and Las Valles (5900 ft.) New Mexico, by T. D. A. Cockerell, are but little larger than the typical *molesta* and decidedly darker. At Woodland Park, Colorado (8500 ft.), I have taken a still larger and darker form, the workers of which measure fully 2 mm. and are of a rich chestnut color, with brownish yellow mandibles, legs and antennæ. This may be called var. *castanea* var. nov. It grades into the variety *validiuscula* through smaller and paler forms which I have taken at Manitou and Colorado Springs, Colorado. A cotype of *S. texana* var. *truncorum* Forel, in my collection is very similar to *castanea* but has a paler thorax.

50. **Solenopsis texana** *Emery*.

Solenopsis pollux var. *texana* Emery, Zool. Jahrb., Abth. f. Syst., VIII, 1894, p. 278, ☿.

Solenopsis texana Forel, Soc. Ent. Belg., XLV, 1901, p. 345, ☿ ♀ ♂.

Texas: Austin, June 25; Belton; McNeil; Henrietta (Wheeler).

Forel has described two subspecies of *texana, carolinensis* and *truncorum,* from North Carolina and I have described one (*catalinæ*) from the island of Santa Catalina, Cala. Examination of a cotype specimen sent me by Professor Emery and many workers taken from the above mentioned localities in Texas, convinces me that *texana* is very closely allied to *molesta.* It is somewhat smaller (1–1.2 mm.), of a paler yellow color, has a slightly more rounded epinotum and more nearly equal petiole and postpetiole, but I can detect no other differences of importance. The female measures 3.8 mm., has a brown head and the remainder of the body yellow. The male measures 3.5 mm. and is a deep black, with the appendages, wing veins and venter sordid yellowish. The female of the typical *molesta* is longer (5 mm.) and darker, the male of about the same size, with the head and thorax dark brown and the gaster pale.

51. **Pheidole kingi instabilis** *Emery.*

Pheidole kingi Ern. André subsp. *instabilis* Emery, Bull. Soc. Ent. France, 1901, pp. 120, 121, ♃ ☿; Wheeler. Bull. Amer. Mus. Nat. Hist., XXIII, 1907, pp. 2–4, pl. i and v, figs. 1–9, 63.

Pheidole kingi var. *instabilis* Forel, Ann. Soc. Ent. Belg., XLV, 1901, p. 130, ♃ ☿; Wheeler, *ibid.*, p. 203, ♃ ☿.

Soldier. Length: 4.5–5 mm.

Head very large (2 mm. long), oblong, nearly 1½ times as long as broad, with straight, parallel sides, broadly and angularly excised posterior margin and a broad, deep groove extending forward from the occiput, nearly to the frontal area. Posterior corners angular. Eyes small, less than ½ the distance from the anterior to the posterior corners of the head. Mandibles convex, with two large, blunt apical teeth. Clypeus broad and short, without a median carina, but with a large median notch in the anterior border. Frontal area distinct, subtriangular, without a median carinula. Frontal carinæ short and small. Antennæ very short and slender, the tip of the scape reaching only to the eye; all the joints of the funiculus longer than broad; club shorter than the remainder of the funiculus. Pronotum less than half as broad as the head, convex above, with rounded but distinct humeri. Promesonotal suture distinct. Mesonotum rather angular and convex behind, but without a distinct torulus. Epinotum short, with subequal base and declivity, concave in the middle between the spines, which are acute, about as long as broad and twice as far apart as broad at their bases, directed upwards. Petiole twice as long as broad, violin-shaped, hardly broader behind than in front, with concave sides. Node compressed antero-posteriorly, with horizontal and rather thin upper border. There is no anteroventral tooth. Postpetiole hardly twice as broad as the petiolar node, fully twice as broad as long. Gaster circular or broadly elliptical, much smaller than the head, flattened dorso-ventrally.

Mandibles and clypeus shining, the former coarsely and sparsely punctate, the latter longitudinally rugose, especially on the sides. Head subopaque, or glossy; somewhat more shining in the middle, sculptured throughout, the cheeks and front being rather finely longitudinally rugose, the posterior half transversely rugose and punctate, the rugæ becoming coarser on the posterior corners. Thorax subopaque, more shining on the pro- and mesonotum, finely and irregularly striate or rugose; the striæ being more distinct on the pro- and mesonotum, the punctures on the side; epinotum punctate. Petiole and postpetiole subopaque, with shining nodes. Gaster smooth and shining, with scattered piligerous punctures.

Hairs yellow, erect, moderately long and abundant on the body, legs and antennal scapes.

Head rich ferruginous red; borders of mandibles and anterior border of clypeus broadly blackened. Thorax, petiole, postpetiole, legs and antennæ more piceous brown, with yellow joints and sutures. Gaster black or dark brown.

Worker. Length: 1.5–1.8 mm.

Head, excluding the mandibles a little longer than broad, rectangular, with distinctly excised posterior border. Mandibles with two acute apical and several smaller basal teeth. Clypeus rather flat, with a distinct median excision in the anterior border. Frontal area distinct, subelliptical. Frontal carinæ small. Eyes just in front of the middle of the head. Antennæ resembling those of the soldier but with proportionally shorter clubs and the scape extending a little beyond the posterior corners of the head. Thorax in profile much flatter dorsally than the soldier's, especially in the promesonotal region, and the epinotal spines very minute, in some specimens almost obsolete. Petiole fully three times as long as broad, somewhat broader behind than in front where it is pedunculate; node small and rounded; postpetiole a little broader than the node of the petiole, about as broad as long, subglobular. Gaster about as large as the head. Legs rather long.

Smooth and shining; mandibles subopaque, striated; cheeks longitudinally rugose. Mesopleuræ and epinotum evenly punctate.

Hairs yellow, suberect, very sparse on the head, thorax and gaster, more abundant and shorter on the antennal scapes and legs.

Dark brown or piceous, head and gaster often somewhat darker than the thorax and pedicel; mandibles, legs and antennæ sordid yellowish or brownish yellow. In many specimens the greater portion of the femora and tibæ is dark brown.

Intermediates. Length: 2–4 mm.

These combine the characters of the soldier and worker in varying degrees according to their size. In the largest individuals the head is proportionally smaller than that of the soldier, with the longitudinal rugæ on the anterior half of the head, but only the sparse punctures of the soldier on the posterior half, so that this region is shining. The head grows proportionally shorter, smoother and darker in color and the antennæ longer, as we pass down the series to the forms most like the worker and differing from it only in having somewhat larger heads, with the longitudinal rugæ confined to the anterior third, and very small scattered punctures on the posterior portion. At the same time the mandibles become less convex and more acute, the occipital furrow more shallow without disappearing completely, the striæ become obsolete on the promesonotum, the epinotal spines become smaller and the petiole and postpetiole come to resemble those of the typical worker.

Female. Length: 5–6 mm.

Head, excluding the mandibles as long as broad, with broadly excised posterior border. Mandibles, clypeus and antennæ similar to those of the soldier, scapes reaching to half way between the eyes and the posterior corners of the head. Eyes and ocelli large. Thorax with much flattened mesonotum and scutellum, as broad as the head through the wing insertions. Epinotum with very thick, blunt spines. Petiole and postpetiole similar to those of the soldier. Gaster elongate elliptical, flattened dorsoventrally, as long as the thorax. Legs rather slender.

Mandibles coarsely striatopunctate, thoracic dorsum somewhat shining in spots. Head subopaque, covered with longitudinal rugæ which diverge on the occiput and are separated by shallow punctures. Mesonotum and scutellum sparsely punctate, the former with an area of fine longitudinal striæ posteriorly. Epinotum, petiole and postpetiole opaque, granular; nodes more shining. Gaster shining, sparsely and irregularly punctate.

Hairs erect or suberect, yellow, more abundant than in the soldier, covering the body, legs and antennal scapes.

Dark brown or black. Mandibles, clypeus and head in front of ocelli, legs and antennæ reddish yellow. Wings rather opaque, smoky, with yellow veins and brown stigma.

Male. Length: 3.5–4 mm.

Head, excluding the eyes, a little longer than broad, with extremely short cheeks and more extensive postocular border. Eyes and ocelli very large. Mandibles small, with a few minute teeth. Clypeus convex, with rounded anterior margin. Antennal scapes small and slender, shorter than the two basal joints of the funiculus taken together; first joint globular, remaining joints subequal, cylindrical. Thorax robust, flattened dorsally, considerably broader than the head. Epinotum with angular swellings in the place of the spines. Petiole and postpetiole robust, node of the former large, low and rounded. Postpetiole about twice as broad as the petiole, broader than long, broadest behind, with sides somewhat angular in the middle. Gaster of the usual shape. Legs long and slender.

Smooth and shining; head, excepting the mandibles and clypeus, opaque, finely rugulose-punctate. Metapleuræ and epinotum opaque and finely punctate.

Hairs yellow, shorter and sparser than in the female.

Mandibles, anterior border of clypeus, antennæ and legs sordid yellow. Head and gaster black; clypeus, thorax, pedicel and genitalia brown, with sordid yellow sutures. Wings like those of the female but with somewhat paler stigma.

Texas: Austin; Del Rio (Wheeler); Barksdale (Brown).

Mexico: Cuernavaca (Wheeler).

I have described this species at length since it belongs to a group of *Pheidole* with highly polymorphic workers, concerning which there is some confusion in the literature. Emery believes that the typical *kingi* André and *townsendi* André are based on the soldier and intermediate of the same species. Similarly, according to this authority, *Ph. tepicana, rugifrons* and *carbonaria* were all described by Pergande from different forms of the same species. For an account of the habits and parasites of *instabilis* see my article in the Bull. Am. Mus. Nat. Hist., XXIII, 1907, pp. 2–12.

52. **Pheidole pilifera coloradensis** *Emery.*

Pheidole pilifera (Roger) var. *coloradensis* Émery, Zool. Jahrb., Abth. f. Syst., VIII, 1893, pp. 290, 291, ♃ ☿.

Soldier. Length: 4–4.5 mm.

Allied to *Ph. pilifera.* Head large, excluding mandibles a little longer than broad, with parallel sides, rounded posterior corners, deeply excised posterior border and pronounced vertical groove which is continued forward to the frontal area. Mandibles convex, with two apical, two small basal and a few irregular intermediate teeth. Clypeus short, with a median carina, and very faintly and sinuately excised anterior margin. Frontal area subtriangular, moderately impressed, with a median carinula. Eyes rather large, about ¼ the distance from the anterior to the posterior corner of the head. Frontal carinæ very short, each continued as a ridge mesially bounding a distinct depression as long as the antennal scape. Antennæ slender; scapes reaching a little behind the posterior borders of the eyes; club somewhat shorter than the remainder of the funiculus, joints 2–8, about as long as broad. Thorax in front about half as broad as the head, with distinct humeral callosities. Promesonotum without a transverse constriction; convex and somewhat angular behind. Mesoëpinotal constriction pronounced. Base and declivity of epinotum of about equal length, concave between the spines which are robust, erect and blunt at their tips, somewhat more than half as long as the basal surface and further apart than long. Petiole from above nearly square, with abrupt, anteroposteriorly compressed and deeply notched node; in profile without a median ventral tooth. Postpetiole more than twice as broad as the petiole and fully three times as broad as long, with prominent lateral conules which are convex anteriorly and concave posteriorly. Gaster elliptical, smaller than the head. Legs rather long.

Mandibles shining, coarsely punctate, at the base longitudinally rugose. Clypeus irregularly rugose throughout. Head subopaque, more shining on the posterior half. Cheeks and anterior half of upper surface longitudinally punctate-rugose; smoother behind, with large elongate foveolæ scattered over the surface, and finely granular along the groove to the occiput. Thorax subopaque, middle of promesonotum and epinotum narrowly shining. Surface of former rugulose-punctate, latter densely punctate. Petiole subopaque, finely granular on the sides. Postpetiole shining above. Gaster smooth and shining.

Hairs dark yellow, erect or suberect, rather short and moderately abundant, covering the surface of the body, legs and antennal scapes.

Dark brown; mandibles legs and anterior fourth of head reddish yellow. Border of mandibles and anterior border of clypeus black. Antennæ, posterior portion of head and sides of thorax light brown, clubs of antennæ infuscated. Posterior edges of gastric segments yellowish.

Worker. Length: 2–2.3 mm.

Head, excluding mandibles, as broad as long, with straight posterior border. Eyes nearly as large as those of the soldier, a little in front of the middle of the head. Clypeus with broadly rounded, entire anterior border. Antennæ slender; scape extending nearly three times its apical diameter beyond the posterior corners of the head. Thorax resembling that of the soldier but humeri less pronounced and epinotal spines more slender. Petiole from above oblong, fully twice as long as broad, as broad in front as behind, with slightly concave sides; node similar to that of the soldier. Postpetiole about twice as broad as the petiole, somewhat broader than long, with the sides rather sharply angled in the middle. Gaster somewhat smaller than the head.

Head, thorax and petiole opaque, densely punctate; mandibles and cheeks longitudinally striated. Posterior portion of the clypeus, frontal area, postpetiole and gaster smooth and shining.

Hairs whitish; very sparse, suberect on head and body; short and appressed on the legs and antennal scapes.

Dark brown, head darker, often black; mandibles, clypeus, cheeks, legs and antennæ much paler.

Female. Length: 6–6.5 mm.

Head, excluding the mandibles, slightly broader than long, a little broader behind than in front, with very faintly and broadly excised posterior margin. Mandibles, clypeus and antennæ similar to those of the soldier. Tip of scape reaching to half the distance between the eye and the posterior corner of the head. Thorax robust, through the wing insertions as broad as the head. Mesonotum and scutellum flattened. Epinotum like that of the soldier, spines very robust, obtuse, more than twice as far apart as long, directed backward and upward. Petiole similar to that of the soldier but with very acute tooth-like anterior corners and slightly concave sides. Postpetiole nearly three times as broad as the petiole and three times as broad as long, with the sides prolonged into long, rather blunt conules which are convex anteriorly and slightly concave posteriorly. Gaster oblong elliptical, about the size of the thorax.

Mandibles shining, coarsely punctate and towards the base striate; clypeus and head subopaque, the former irregularly rugose, the latter rather coarsely and longitudinally rugose, with punctate interrugal spaces and depressions for the antennæ. Mesonotum and scutellum coarsely and sparsely punctate, the former with fine longitudinal striæ on its posterior half. Epinotum subopaque, punctate-rugulose on the sides and with coarse transverse rugæ between the spines. Petiole and postpetiole subopaque, the former finely, the latter more coarsely punctate. Gaster shining, very finely shagreened.

Hairs yellow, abundant, suberect, more appressed on the gaster and dorsal portion of thorax.

Very dark brown, almost black; mandibles, clypeus, anterior third of head, legs and antennæ, except their clubs, yellowish brown. Wings yellowish hyaline, with yellow veins and stigma.

Male. Length: 4–4.3 mm.

Head, excluding the mandibles, about as broad as long, rounded and prominent behind, with very short cheeks. Mandibles small, tridentate. Clypeus convex, with entire anterior border. Antennal scape distinctly shorter than the two first funicular joints together, first funicular joint elliptical, distinctly longer than broad, but broader than the succeeding subequal and cylindrical joints. Thorax decidedly broader than the head through the eyes, long and flattened above. Epinotum with evenly convex basal surface as long as the nearly vertical declivity; spines minute, about as long as broad at their bases and very acute. Petiole from above oblong, with a conical rounded node; postpetiole about twice as broad as the petiole and nearly twice as broad as long, with rather acutely angled sides. Gaster and legs as usual.

Mandibles and clypeus subopaque, the former minutely striate; head subopaque, rather coarsely longitudinally punctate-rugose in front of the ocelli, transversely rugose between the paired ocelli. Thorax subopaque. Mesonotum finely and longitudinally striated but smooth and shining in the middle and on each parapsis. Mesopleuræ with similar sculpture but smooth and shining below. Scutellum very coarsely punctate. Epinotum granulate-rugose, the rugæ being regularly transverse on the declivity but indistinct and more irregular on the sides. Gaster smooth and shining.

Hairs sordid white, short, suberect and rather abundant, especially on the head and thorax; conspicuous on the legs, but short and delicate on the antennæ.

Black or dark brown; mandibles, antennæ, legs, wing insertions, posterior edges of gastric segments and genitalia sordid yellow. Wings like those of the female.

Colorado: West Cliff, Boulder and Pueblo (P. J. Schmitt); Colorado Springs and Buena Vista (Wheeler).

New Mexico: Pecos, Old Pecos Pueblo and Las Vegas (T. D. A. Cockerell).

The specimens from New Mexico differ from the typical form in having the occipital region of the head finely and transversely rugose, and may be regarded as representing a distinct variety, *neomexicana* var. nov.

Ph. coloradensis was regarded by Emery as merely a variety of the eastern *pilifera*, but I believe that it is sufficiently constant to be elevated to the rank of a subspecies. The head is much smaller and very differently sculptured. In the soldier of the typical *pilifera* from Illinois and Kentucky the whole head is opaque, especially behind and in that region coarsely reticulate rugose and the postpetiole is proportionally longer and narrower, with blunter lateral conules. Among my specimens I am able to recognize two distinct forms from the Eastern States. The soldier of one of these, which must be similar to the form mentioned by Emery from Carolina, has the head sculptured much like *coloradensis* behind, that is, shining and grossly punctate or foveolate, but the occipital portion is crossed by transverse rugæ which are very distinct in the occipital notch. This form which I have taken near Bronxville, New York, and at Great Notch, New Jersey, and have received from Boonton, New Jersey (H. Viereck) may be called var. *simulans* var. nov. It is clearly transitional to the western form in the shape of the postpetiole, although the head is nearly as large as in the typical *pilifera*. Another form which I have taken on Long Island and have received from Massachusetts (G. B. King) has a much shorter head, which, excluding the mandibles, is but little longer than broad. The longitudinal rugæ of the fore part converge towards each other on the occipital lobes and meet in the occipital groove thus producing a very different appearance from that of the soldier of the typical *pilifera.* The pro- and mesonotum are transversely reticulate rugose, the epinotal spines acute and directed upward. The postpetiole has acute lateral conules. This form may be called *septentrionalis* subsp. nov.

The habits of *Ph. coloradensis, simulans* and *septentrionalis* are very similar to those of *pilifera.* They live under stones or in small crater nests and store their chambers with the seeds of grasses and other plants.

53. **Pheidole ceres** *Wheeler.*

Pheidole ceres Wheeler, Bull. Am. Mus. Nat. Hist., XX, 1904, pp. 10–13, ♃ ☿ ♀ ♂; *ibid.*, XXII, 1906, p. 337; *ibid.*, XXIII, 1907, p. 14.

Colorado: Ute Pass, Cheyenne Mt., Woodland Park, and Florissant (Wheeler), Boulder (P. J. Schmitt, T. D. A. Cockerell).

New Mexico: San Geronimo and Manzanares (Miss Mary Cooper), San Ignacio and Las Vegas (T. D. A. Cockerell.)

Arizona: Grand Cañon, (Wheeler).

Texas: Ft. Davis (Wheeler).

This ant lives under stones in rather dry situations at an altitude of 5000–9000 ft. It garners seeds like the preceding species. It resembles *Ph. pilifera coloradensis* in the sculpturing of the head of the soldier, but is much smaller and the worker is smooth and shining instead of opaque and punctate.

In two colonies taken at Fort Davis and infested with Chalcided parasites (*Orasema wheeleri* Ashm.) there were a few individuals intermediate in the size and sculpture of the head between the soldiers and workers. I have never found this condition in the uninfested colonies in this or other localities.

54. **Pheidole proserpina** sp. nov.

Soldier. Length: 2.6–3 mm.

Allied to *Ph. ceres.* Head of moderate size, excluding the mandibles a little longer than broad, slightly narrower behind than in front, with excised posterior border and deep occipital furrow. Mandibles convex, with two large apical teeth. Clypeus very short, with a median carina and a deep notch in the middle of the anterior border. Eyes rather large, flattened, ¼ the distance from the anterior to the posterior corners of the head. Frontal area small, impressed, subtriangular, without a median carinula. Frontal carinæ short. Antennal scapes curved at the base, their tips reaching to about ⅓ the distance from the eye to the posterior corner of the head; club much shorter than the remainder of the funiculus; joints 2–8 as long as broad. Thorax robust, in front about half as broad as the head, with prominent but rounded humeri. There is a distinct transverse depression between the pro- and mesonotum and the latter is elevated to form a distinct torus. Epinotum with subequal base and declivity, the former rather flat and forming an obtuse angle with the latter, concave between the spines which are acute, longer than broad at the base and directed backward and slightly upward and outward. Petiole about twice as long as broad, much broader behind than in front, with concave sides; node compressed anteroposteriorly, its upper border seen from behind transverse, distinctly emarginate in the middle. Postpetiole hardly twice as long as the petiolar node, nearly three times as broad as long, with short and rounded lateral angles. Gaster broadly elliptical, about the size of the head. Legs rather long.

Mandibles and clypeus shining, the former distinctly striated and sparsely punctate; clypeus, cheeks and front back to a level with the eyes finely longitudinally striated, followed by a narrow opaque zone of very fine punctures, at the level of the eyes; more than the posterior half of head smooth and shining, with indistinct scattered punctures. Thorax, petiole and postpetiole opaque, finely and densely punctate throughout, pronotum and petiolar node in some specimens somewhat shining. Gaster shining, very finely shagreened.

Hairs sparse, suberect, rather long, yellowish on the body, legs and antennal scapes.

Black; mandibles and clypeus, except their borders, the cheeks in front of the eyes, chin, legs and posterior edges of gastric segments ferruginous yellow, sides of thorax and femora brown.

Worker. Length: 2–2.3 mm.

Head, excluding the mandibles, somewhat longer than broad, with rather convex lateral and straight posterior border. Mandibles with two large apical and several small basal teeth. Clypeus rather convex, with a distinct median notch in its border. Antennæ slender, scapes extending about ¼ their length beyond the posterior corners of the head. Thorax similar to that of the soldier, but with more rounded pronotum. Mesonotum convex and separated by a transverse depression from the pronotum in front and from the epinotum behind. Basal surface of latter flattened, longer than the declivity. Spines acute, similar to those of the soldier, but more vertical. Petiole slender, nearly three times as long as broad, widest behind, with concave sides. Node similar to that of the soldier and with a faint median depression in its upper border. Postpetiole about half again as broad as the petiolar node, a little broader than long, with roundly angulate sides. Gaster somewhat larger than the head.

Mandibles and clypeus subopaque, the former coarsely punctate, except at the base, where they are very finely striated, the latter and the cheeks with coarse longitudinal rugæ. Front finely striated anteriorly. Head finely and regularly reticulate on the sides and occiput but smooth and shining on the vertex. Thorax, petiole and postpetiole subopaque, finely and regularly reticulate throughout, middle of pronotum in some specimens somewhat shining. Gaster glabrous.

Hairs whitish, long, obtuse, but not enlarged at their tips; very sparse and suberect; conspicuous on the scapes and legs.

Piceous brown; head and gaster darker, clypeus paler. Mandibles and anterior corners of head yellow.

Described from several soldiers and workers taken from a single nest under a stone on the banks of the Gila River at Tempe, Arizona.

This species is closely related to *Ph. ceres* but differs in the sculpturing of the head and thorax of both soldier and worker, the more acute epinotal spines and notched petiolar node of the soldier.

55. **Pheidole soritis** sp. nov.

Soldier. Length: 3.3–3.5 mm.

Allied to *Ph. ceres*. Head large, excluding the mandibles distinctly longer than broad, about as broad behind as in front, with slightly convex sides and moderately deep occipital excision and groove, and a rather broad vertical depression in the region of the groove. Eyes rather large, moderately convex, ⅓ the distance from the anterior to the posterior margin of the head. Mandibles convex, with two large blunt apical teeth. Clypeus short, rather feebly carinate in the middle and with a small median notch in its anterior border. Frontal area deeply impressed, straight in front, rounded behind, without a median carinula. Frontal carinæ very short. Antennæ slender, scapes reaching only a short distance beyond the posterior corner of the eye; club as long as the remainder of the funiculus, joints 2–8 about as broad as long. Thorax rather slender, in front less than half as broad as the head, humeri rounded; mesonotum convex and separated by a distinct transverse depression from the moderately convex pronotum, its posterior surface flattened. Epinotum with subequal base and declivity, concave between the spines, which are rather blunt, directed outward and backward and barely longer than broad at their bases, which are continued forward and backward as prominent ridges bordering the depressed median portion of the epinotum. Petiole twice as long as broad, distinctly broader behind than in front, with slightly concave sides. Node rather thick, with blunt transverse upper border, not impressed in the middle. Postpetiole less than twice as broad as the petiole, broader than long, with angular lateral corners, which are rather acute in some specimens and very blunt in others. Gaster elongate elliptical, smaller than the head. Legs rather long and slender.

Mandibles shining, striated at their bases and elsewhere with coarse elongate punctures. Head subopaque or glossy, frontal area very smooth and shining. Clypeus finely longitudinally rugose in the middle. Head covered with longitudinal rugæ separated by faintly punctate interrugal spaces. Along either side of the occipital groove the longitudinal become continuous with a system of transverse rugæ on each occipital lobe and these in turn are continuous anteriorly with the longitudinal rugæ on the sides of the head. Just in front of the occipital lobes the sculpture on the upper side is somewhat fainter, so that the surface is more shining, and in this region there are scattered elongate punctures in addition to the rugosity. Thorax, petiole and postpetiole opaque, densely punctate, except the pro- and mesonotum, which are finely and sharply transversely rugose. Gaster smooth and shining.

Hairs glistening white, sparse, suberect and not very abundant, appressed and inconspicuous on the legs. The antennal scapes have only a few suberect hairs and these are on the anterior surfaces.

Black: head deep reddish brown; mandibles except their borders, cheeks, chin and sides of clypeus, legs, antennæ and articulations of pedicel and thorax, yellowish brown.

Worker. Length: 2–2.3 mm.

Head rectangular, excluding the mandibles hardly longer than broad, with straight posterior margin and very large prominent eyes which are just in front of the middle. Mandibles with several teeth, those at the base being but little smaller than the two at the apex. Clypeus convex, with a faintly emarginate anterior border. Antennæ extending beyond the posterior corners of the head to a distance barely exceeding the diameter of their tips. Thorax similar to that of the soldier but there is no sharp transverse impression between the pro- and mesonotum so that in profile these two regions seem to be almost continuous and have a low rounded outline. Epinotal spines small, blunt and tooth-like, directed upward. Petiole slender, nearly three times as long as broad, slightly broader behind, with a rounded conical node. Postpetiole somewhat broader than the petiolar node, nearly as long as broad, with slightly angular sides. Gaster elongate elliptical, about as large as the head. Legs slender.

Smooth and shining, mandibles subopaque, very finely striated. Cheeks and frontal region with fine longitudinal rugæ. Pleuræ, meso- and epinotum, petiole and postpetiole opaque, densely and uniformly punctate; anterior portion of mesonotum and upper surface of petiole and postpetiole more shining, like the pronotum and back of head. Gaster glabrous.

Hairs whitish, short, obtuse and very sparse, on the legs delicate and appressed.

Black; mandibles except the teeth, clypeus, antennæ, tarsi and bases and tips of femora and tibiæ, brownish yellow; antennal clubs dark brown.

Described from numerous soldiers and workers taken from a single colony nesting under a stone in the desert near Albuquerque, New Mexico. In this species the head of the soldier is proportionally longer and larger than in *ceres* and *proserpina* and the rugose sculpturing is very different, extending, as it does, over the whole head and looping around the occipital lobes. There can be little doubt that both this and the preceding species are harvesting ants like *Ph. ceres.*

56. **Pheidole sitarches** sp. nov.

Soldier. Length: 3–3.5 mm.

Head large, excluding the mandibles, longer than broad, very nearly as broad behind as in front, with subparallel sides, and deep occipital groove and incisure. There is a pronounced depression at the groove and the middle of the head is convex. Mandibles convex, with two large apical and two small basal teeth. Clypeus short, carinate, with a small but distinct median notch in its anterior border. Frontal area impressed, triangular, somewhat rounded behind, with a median carinula. Frontal carinæ short. Antennæ slender, scape reaching to posterior corner of eye, which is large and flat and situated less than ⅓ the distance from the anterior to the posterior corner of the head; antennal club shorter than the remainder of the funiculus; joints 2–8 slightly longer than broad. Thorax short, robust, in front nearly half as broad as the head. Humeri prominent but rounded. Mesonotum convex and somewhat angular, separated by a rather shallow transverse groove from the pronotum, but by a deep constriction from the epinotum. The latter with subequal and declivous surfaces, meeting in a concavity between the spines, which are rather acute, as long as broad at the base and directed upward, backward and outward. The spines are laterally compressed and their bases are continued forward and backward as ridges bounding the epinotal concavity on each side. Petiole suboblong, twice as long as broad, nearly as broad in front as behind, with concave ridges and rather prominent anterior angles; node considerably compressed anteroposteriorly, with transverse upper border, distinctly excised in the middle. Postpetiole nearly twice as broad as the petiole, somewhat more than twice as broad as long, with prominent lateral conules. Gaster broadly elliptical, flattened, much smaller than the head. Legs rather slender.

Mandibles shining, with coarse, elongate punctures. Clypeus subopaque, longitudinally rugose. Frontal area shining, Head opaque, very finely and densely punctate throughout and with fine longitudinal rugæ on the anterior half along each side of the occipital groove, where they pass over into a faint system of fine transverse rugæ on the occipital lobes, but become obsolete on reaching the posterior corners of the head. Thorax, petiole and postpetiole opaque, finely and densely punctate; promesonotum also somewhat irregularly rugulose above. Gaster smooth and shining.

Hairs pale yellowish or white, suberect and rather long, pointed on the head and appendages, obtuse and clavate on the thorax, petiole and gaster. On the gaster they are very regular and conspicuous. Antennal scapes and legs with delicate appressed hairs, the former also with a few coarse, erect hairs on their anterior surfaces.

Ferruginous red; borders of mandibles, gaster and upper portion of thorax, petiole and postpetiole black. Legs yellowish. Antennæ of the same color as the head, which is usually ferruginous but may vary to dark brown in soldiers of the same colony.

Worker. Length: 1.4–1.6 mm.

Head, excluding the mandibles, a little longer than broad, rectangular, with very faintly emarginate posterior border and eyes in front of the posterior half. Mandibles with several teeth, the apical pair of which are only slightly longer than the others. Anterior border of clypeus very faintly and sinuately emarginate in the middle. Tips of antennal scapes reaching only a little beyond the posterior corners or the head. Thorax resembling that of the soldier, pronotum rather depressed above, with a feeble promesonotal depression. Epinotal spines small and rather acute, directed upward. Petiole about twice as long as broad, somewhat broader behind than in front, node somewhat compressed as in the soldier but not emarginate above. Postpetiole a little broader than the petiolar node and a little broader than long, with indistinctly angulated sides. Gaster elongate elliptical, smaller than the head.

Smooth and shining; mandibles opaque, finely striatopunctate, cheeks and front with fine longitudinal striæ. Mesopleuræ, epinotum, petiole and postpetiole opaque, densely and uniformly punctate, upper surfaces of nodes somewhat shining.

Pilosity similar to that of the soldier but the hairs are less abundant and are obtuse also on the head. There are no erect hairs on the antennal scapes.

Black or dark brown; gaster usually darker than the head, thorax and pedicel; mandibles, clypeus and anterior portion of head, antennæ and legs more or less yellow.

Female. Length: 4–4.3 mm.

Head, excluding the mandibles, about as long as broad, rectangular, with nearly straight posterior border and parallel sides. Eyes large, just in front of the middle of the sides. Clypeus and mandibles like those of the soldier. Frontal area short, crescentic. Antennal scapes reaching about ⅓ the distance from the eye to the posterior corner of the head. Thorax but little broader than the head, flattened above. Epinotal spines robust, short and rather acute, directed backward, outward and upward. Petiolar node high and much compressed anteroposteriorly, its summit rounded, not impressed in the middle. Postpetiole barely twice as broad as the petiole, about 2½ times as broad as long, with prominent but rather blunt lateral conules. Gaster elongate elliptical.

Head, thorax and pedicel opaque; mandibles very coarsely striatopunctate, head traversed by coarse longitudinal rugæ, separated by rather wide reticulate interstices, the rugæ diverging to the posterior corners of the head. Mesonotum and scutellum shining, the former coarsely and sparsely punctate, with two densely striated posteromedian areas. Mesopleuræ shining, coarsely punctate above. Epinotum coarsely rugose-punctate, smooth between the spines. Petiole and postpetiole finely and obscurely punctate.

Hairs sordid yellow, pointed, rather abundant, suberect, shorter and more appressed on the antennæ and legs.

Dark brown; gaster, pedicel, epinotum and mandibular teeth black; mandibles, antennæ and legs dull yellowish red.

Texas: Mount Barker near Austin; New Braunfels (Wheeler).

This species seems to be very variable. The form which I regard as typical has the rugosity perceptible over the whole surface of the head and the thorax and pedicel are decidedly blackened, at least on the dorsal surface. It is rather closely related to *Ph. soritis* but the petiole has a very different shape and the coloration and pilosity are different. The head sometimes varies considerably in size in soldiers of the same nest, reminding one of the conditions in *Ph. instabilis*. *Ph. sitarches* nests under stones. In the neighborhood of Austin I have found it only among the dry limestone hills of the Edwards Plateau escarpment. It collects and stores seeds, but is quite unable, as I have observed on several occasions, to prevent them from germinating in the chambers of the nest during damp weather.

57. **Pheidole sitarches** var. **transvarians** var. nov.

Both the soldiers and workers of this form show a distinct transition to the following subspecies *rufescens*. The head of the soldier is dull and opaque behind and the rugæ are discernible only on the occipital lobes, where they are often very faint, and on the front where they are more distinct. The head is ferruginous, without any trace of infuscation, the neck, ventral portion and sutures of the thorax are also reddish. The workers are much paler than in the typical *sitarches*, but the head is smooth and shining and does not show any of the sculpture so characteristic of the worker of the following subspecies. I have seen only soldiers and workers which were taken from a single colony on Mt. Barker near Austin Texas.

58. **Pheidole sitarches rufescens** subsp. nov.

Soldier: Head with the sculpture of the preceding variety, the transverse striæ on the occipital lobes often obsolete or obsolescent. Epinotal spines very blunt, erect. Head, thorax and pedicel reddish yellow, base of first gastric segment, antennæ and legs paler. Borders of mandibles black.

Worker: Head and thorax finely and densely punctate; the former smooth and shining only in the middle of the front and on the vertex, the latter somewhat shining on the middle of the mesonotum. Color like that of the soldier except that the head is yellow with much of the upper surface infuscated.

Female. The head, thorax, pedicel and basal third of the gaster are rich ferruginous red and the legs and antennæ are scarcely paler. Wings yellowish hyaline, with yellow veins and brown stigma.

Texas: Bull Creek, Walnut Creek, Mt. Bonnel, Mt. Barker near Austin, San Angelo (Wheeler).

This form may be readily distinguished from the typical *sitarches* by its color, the less pronounced rugosity of the head and especially by the largely punctate head and pronotum of the worker. In no case, however, is there a tendency to infuscation of the head in the soldiers though this may vary considerably in size in individuals from the same colony, as in the typical form. A number of soldiers collected by Father P. J. Schmitt at Doniphan, Missouri appear to belong to this subspecies.

The habits of *rufescens* are the same as those of the typical *sitarches* and it occurs in the same localities.

59. **Pheidole sitarches rufescens** var. **campestris** var. nov.

The soldier of this form which I have taken at Henrietta, Texas, agrees very closely with that of *rufescens*. It is somewhat larger (3.6 mm.) and the petiole is broader behind. The worker, however, has the head and thorax entirely opaque and densely punctate, and as it is also darker in color than *rufescens* it closely resembles the worker of *Ph. pilifera*.

60. **Pheidole sciophila** sp. nov.

(Pl. XXVI, Figs. 18 and 19.)

Soldier. Length: 2.8–3 mm.

Head rather small, excluding the mandibles a little longer than broad, rectangular, with rather straight subparallel sides, broadly and angularly excised posterior margin and rather deep and narrow occipital groove. Eyes moderate, slightly convex, about ⅓ the distance from the anterior to the posterior corners of the head. Mandibles convex, with a single basal and two large acute apical teeth. Clypeus short, convex in the middle, without a median carina but with a median notch in the anterior border. Frontal area small, impressed, triangular, with a distinct median carinula. Frontal carinæ about ⅓ as long as the antennal scapes. Antennæ well developed, scape curved and distinctly flattened at the base, reaching half the distance between the eye and the posterior corner of the head; club shorter than the remainder of the funiculus, joints 2–8 longer than broad. Thorax robust, in front half as broad as the head, with prominent, angular humeri. Pronotum flattened posteriorly and with marginate sides. Mesonotum in profile low, but angular and separated by a distinct transverse depression from the pronotum and behind by a similar but deeper depression from the epinotum. Epinotum in profile with subequal base and declivity, but between the spines forming a single concave sloping surface. Spines longer than broad at the base, acute, directed backward, outward and slightly upward, their bases continued anteriorly and posteriorly to form ridges bounding the sloping space between. Petiole about twice as long as broad, distinctly broader behind in the region of the node and with acutely angular anterior corners. Node much compressed anteroposteriorly, with a rather sharp, indented upper margin. Postpetiole barely twice as broad as the petiolar node, less than twice as broad as long, broader in front, where it has rather rounded lateral angles. Gaster broadly elliptical, distinctly smaller than the head. Legs moderate.

Mandibles shining, coarsely punctate. Clypeus smooth in the middle, opaque on the sides where it is obscurely rugose. Head opaque except the posterior corners which are shining and very coarsely and sparsely punctate. The opaque portion is very densely and uniformly punctate, cheeks and the anterior half of the front also longitudinally rugulose. Thorax, petiole and postpetiole opaque, densely and finely punctate; the pro- and mesonotum also obscurely and sparsely rugulose. Gaster smooth and shining, base of the first segment subopaque and granular.

Hairs sordid yellowish, very long, acute, suberect and sparse; most conspicuous and regular in their arrangement on the gaster. Scapes and tibiæ with very few erect hairs, the remaining hairs on the appendages shorter and more appressed.

Dark brown; mandibles, cheeks, chin and tarsi brownish yellow; clypeus and antennal clubs somewhat lighter than the head; gaster and inner borders of mandibles black.

Worker. Length: 1.8–2 mm.

Head, excluding the mandibles, a little longer than broad, with evenly rounded sides and straight posterior margin. Eyes in front of the middle of the sides. Mandibles with two somewhat larger apical and several minute basal teeth. Clypeus convex, with hardly a trace of a median notch in the anterior border. Antennæ long and slender; scapes not curved or flattened at the base, surpassing the posterior corners of the head by about ⅓ of their length. Thorax more slender and with much more rounded humeri and pronotum than in the soldier; mesonotum depressed. Base of epinotum longer than the declivity and flattened rather than concave. Spines similar to those of the soldier, shorter than the distance separating their bases and directed more upward. Petiole nearly three times as long as broad, very slightly broader behind than in front; node compressed anteroposteriorly but with entire upper border. Postpetiole a little broader than the petiole and slightly broader than long, with rounded sides. Gaster about the size of the head, somewhat narrowed anteriorly and with straight anterior border. Legs rather long.

Mandibles and clypeus shining, the former with their blades coarsely punctate and their bases finely striated. Head, thorax, petiole and postpetiole opaque and densely punctate; a longitudinal strip on the front and vertex as broad as the distance between the frontal carinæ smooth and shining; cheeks and inner margins of frontal carinæ longitudinally rugose. Gaster smooth and shining.

Hairs similar to those of the soldier, but obtuse on the gaster, though not enlarged at the tips.

Head and gaster black, thorax and pedicel, femora, tibiæ and antennæ dark brown; mandibles, clypeus and tarsi yellowish.

Female. Length: 4.5–5 mm.

Head, excluding the mandibles, distinctly broader than long, broader behind than in front, with nearly straight posterior border. Eyes large, flattened, their posterior orbits at the middle of the head. Mandibles, clypeus and antennæ like those of the soldier. Thorax flattened above. Epinotum with strong acute spines, which are as long as broad at their bases. Petiole and postpetiole similar to those of the soldier, but the lateral angles of the latter more prominent and acute. Gaster elongate elliptical, convex above, with rounded sides.

Mandibles and clypeus shining, the former coarsely striatopunctate, the latter smooth in the middle and rugulose on the sides. Head opaque, only the occiput and extreme posterior corners smooth and shining. Front and vertex covered with rather fine, sharp longitudinal rugæ. On the lateral portions the rugæ are still finer and denser. Pronotum and epinotum opaque, finely punctate-rugulose. Mesonotum, paraptera, scutellum and mesopleuræ glabrous, very sparsely punctate, the punctures on the mesopleuræ being very large. The posterior portion of the mesonotum has a finely striated area on each side of the middle line. Petiole and postpetiole finely punctate-rugulose, the upper surface of the latter somewhat shining. Gaster shining, very finely shagreened.

Hairs pale, erect and extremely sparse; the gaster also with some short appressed hairs. Legs and antennæ with similar appressed hairs, the anterior surface of the scapes with a few long erect ones.

Black; thorax, legs and antennæ dark brown; mandibles, clypeus, cheeks, chin, tarsi, paraptera, sutures and articulations of thorax and legs, dull or brownish yellow. Wings hyaline, with pale yellow veins and stigma.

Male. Length: 3–3.3 mm.

Head, excluding the eyes, distinctly longer than broad, much produced behind, with extremely short cheeks, very large eyes and ocelli. Mandibles very small, their tips barely meeting, bidentate. Clypeus convex behind with rounded anterior border. Antennal scape shorter than the first and second funicular joints together, first funicular joint much swollen, elliptical, longer than broad, remaining funicular joints decreasing in thickness and increasing in length to the tip. Thorax robust, broader through the wing insertions than the head through the eyes. Epinotum with angular projections in the place of the spines. Petiole similar to that of the soldier, but with rounded entire node. Postpetiole a little broader than the petiole, nearly as long as broad, broader behind than in front, rounded above and on the sides. Gaster and legs of the usual structure.

Head, petiole and postpetiole subopaque, very finely and obscurely punctate, the front feebly longitudinally striated. Thorax and gaster smooth and shining.

Hairs yellowish, suberect, rather sparse and short; longest and most conspicuous on the head, epinotum and pedicel.

Head black; clypeus, thorax, pedicel and gaster brown; mandibles, antennæ, thoracic sutures and legs brownish yellow. Wings like those of the female.

Texas: Austin and New Braunfels (Wheeler).

At first sight this species would seem to belong to the same group as *Ph. ceres,* but the structure of the thorax and sculpture of the soldier are very different. The mandibles of *Ph. sciophila* are less convex and more acutely toothed than in the harvesting species, so that I am inclined to believe that this ant is entomophagous. It nests in rather small communities in the shade of thickets and trees near water. The males and winged females were taken June 20 to 22.

61. **Pheidole xerophila** sp. nov.

(Pl. XXVII, Fig. 37.)

Soldier. Length: 4–4.3 mm.

Head, excluding the mandibles, somewhat longer than broad, a little broader behind than in front, with subparallel sides, somewhat flattened dorsoventrally, with deeply and angularly excised posterior border, and narrow occipital groove. Eyes moderate, flattened, ⅓ the distance from the anterior to the posterior corners of the head. Mandibles convex, with two blunt apical teeth and faint traces of a pair of basal denticles. Clypeus very short, rather flat, with distinct median carina and with a broad but shallow median notch in its anterior border. Frontal area large, indistinct, carinulate, fused with the clypeus. Frontal carinæ about ⅓ as long as the antennal scapes. Antennæ small and slender. Scape curved at the base but not flattened, its tip reaching to the posterior orbit; club shorter than the remainder of the funiculus, first funicular joint nearly as long as joints 2–5 together; joints 2–9 as broad as long. Thorax robust, pronotum somewhat less than half as broad as the head, with rounded humeri, very convex above and forming a single mass with the mesonotum which is slightly angular behind. Mesoëpinotal constriction pronounced. Epinotum with subequal base and declivity forming nearly a right angle with each other in profile. Spines short, acute, hardly longer than broad at the base, directed upward and outward; region between the spines with distinctly basal and declivous surfaces though separated by a rounded angle. The bases of the spines are continued anteriorly and posteriorly to form low but distinct ridges bounding the epinotal surface. Petiole but little longer than broad, broader behind than in front, with a high, anteroposteriorly compressed node, with rounded summit, which, seen from behind, is transverse but not impressed in the middle. Petiole half again as broad as the petiolar node, twice as broad as long, with prominent but blunt lateral conules. Gaster broadly elliptical, flattened, smaller than the head. Legs slender and rather short.

Shining; thorax and petiole a little less glabrous than the head and gaster. Mandibles coarsely, uniformly and rather densely punctate. Clypeus and anterior third of head sharply and longitudinal rugose, remainder of the head with sparse, rather small piligerous punctures. Pro- and mesonotum and especially the neck, with fine sharp transverse rugæ. Pleuræ finely, longitudinally rugulose. Epinotum, petiole and postpetiole covered with dense, shallow punctures, except the upper surfaces of the nodes which are rather smooth.

Hairs yellow, erect, abundant, moderately long, covering the body, legs and antennal scapes; most conspicuous on the cheeks and gular surface of the head.

Ferruginous; borders of mandibles black; gaster dark brown or blackish, except the base of the first segment which is ferruginous and the posterior edges of all the segments which are yellow. Legs brownish yellow.

Worker. Length: 2.3–2.5 mm.

Head, excluding the mandibles, a little longer than broad, rectangular, with very faintly excised posterior margin and slightly rounded sides, and eyes in front of its middle. Mandibles with several teeth. Clypeus broadly and sinuately emarginate. Frontal area distinct, faintly impressed, triangular. Tips of antennal scapes extending a short distance beyond the posterior corners of the head; joints 2–8 of funiculus very small, slightly broader than long; club about as long as the remainder of the funiculus. Thorax similar to that of the soldier; epinotal spines very small and acute, directed outward and upward. Petiole more than twice as long as broad, slightly broader behind than in front; node compressed, with entire, transverse upper border. Postpetiole 1½ times as broad as the petiolar node, subrectangular, with rounded anterior corners. Gaster about as large as the head. Legs slender.

Shining; mandibles subopaque, very faintly striated. Cheeks longitudinally rugose, remainder of head glabrous. Epinotum and postpetiole finely and densely punctate, the nodes smoother and somewhat shining.

Hairs pale yellow, similar to those of the soldier but much less abundant. Scapes and legs with a few sparse erect hairs.

Black; gaster and antennal scapes dark brown; mandibles, clypeus, frontal carinæ, extreme bases and tips of antennal scapes, funiculi and iegs brownish yellow.

Male. Length: 4 mm.

Head, excluding the eyes, about as long as broad, produced posteriorly; cheeks short but distinct; eyes and ocelli prominent. Mandibles with a pointed apical and a few very minute basal teeth, their tips overlapping. Clypeus convex, with broadly rounded, entire anterior border. Antennal scape as long as the first two joints of the funiculus; first funicular joint swollen, ovate, a little longer than broad, remaining joints subequal, cylindrical, of uniform breadth. Thorax long and very robust, much broader through the wing insertions than the head through the eyes. Epinotum angular in profile, basal surface longer than the declivity; spines represented by blunt projections. Pedicel robust, similar to that of the soldier; petiolar node more rounded and less compressed anteroposteriorly; postpetiole with more acutely angular sides. Gaster broad, elliptical, and somewhat flattened. Genitalia large and prominent.

Shining; posterior and lateral portions of head opaque, finely granular. Mesonotum and scutellum sparsely punctate. Epinotum and pedicel opaque, the former punctate-rugulose, the latter granular, the nodes shining above.

Hairs yellow, erect and abundant, especially on the thorax, but proportionally shorter than in the soldier.

Black; clypeus, pronotum, pleuræ and venter dark brown; mandibles, antennæ, wing-insertions, paraptera, border of scutellum, articulations of the pedicel, genitalia and legs brownish yellow, the femora and tibiæ somewhat darker. Wings grayish hyaline, with yellow veins and conspicuous dark brown stigma.

Texas: Fort Davis, June 9 (Wheeler).

Although this species is related to the *vinelandica* series, it nevertheless differs from all the other North American species known to me in the flattened and peculiarly sculptured head of the soldier, the shape of the thorax and the pilosity. It inhabits small crater nests in the dry open soil of the desert and is, without doubt, a harvesting species.

62. **Pheidole xerophila tucsonica** subsp. nov.

A number of soldiers and workers taken from numerous crater nests in the deserts about Tucson, Arizona are sufficiently distinct to be regarded as a separate subspecies. The soldiers of this form have a black or very dark cherry red, subopaque and much more heavily sculptured thorax, the transverse rugæ on the pro- meso- and epinotum being very coarse. The petiolar node has a median excision in its border. The worker is somewhat larger than that of the typical form and the whole pro- and mesonotum are opaque and punctate like the epinotum.

63. **Pheidole xerophila tucsonica** var. **gilvescens** var. nov.

Several soldiers and workers taken at Phoenix and Tucson, Arizona represent an apparently constant color variety of *tucsonica*. In the soldier the head, thorax and pedicel are ferruginous, the gaster and legs yellow. The sculpture of the thorax is intermediate between *tucsonica* and the typical *xerophila*. The petiolar node is emarginate. The worker is yellow with the head more reddish above. The pronotum is shining as in the typical *tucsonica*. The spines of the epinotum are extremely small and acute. It is difficult to decide whether this form is to be attached to the typical *xerophila* or to the subspecies *tucsonica*.

64. **Pheidole barbata** sp. nov.

Soldier. Length: 4.5 mm.

Head large, flattened, excluding the mandibles a little longer than broad, with rather convex sides and deeply, angularly excised posterior margin. Occipital groove pronounced but very narrow at the bottom. Eyes moderate, flattened, their posterior orbits somewhat less than ⅓ the distance from the anterior to the posterior corners of the head. Mandibles convex, with two blunt apical teeth. Clypeus short, flattened in the middle, without any trace of a carina, with a shallow, sinuate excision in the middle of its anterior border. Antennæ small and slender; scape curved but not flattened at the base, its tip reaching to the posterior orbit. Club somewhat shorter than the remainder of the funiculus; joints 2–8 of the latter clearly longer than broad. Frontal area shallow, subtriangular, with a rather indistinct median carinula. Frontal carinæ only about ⅓ as long as the antennal scapes. Thorax rather long, with very deep and broad mesoëpinotal constriction, anteriorly ⅓ as broad as the head. Thorax rather slender; pronotum with prominent humeral angles between which its surface is perfectly straight and transverse, so that when seen from the front this portion of the pronotum is rectangular. The mesonotum is convex, hemispherical, separated by a suture and not by a distinct depression from the pronotum; its surface is steep and forms almost a right angle with the base of the epinotum. The latter is straight in profile and somewhat shorter than the declivity with which it forms nearly a right angle. Spines very broad at their bases, short and acute, directed upward and slightly outward. The surface between the spines is concave with a slender median ridge or ruga traversing nearly its entire length. Petiole about 1⅔ as long as broad, somewhat broader behind than in front, with slightly concave subparallel sides and distinct anterior angles; node not compressed anteroposteriorly, but with long flattened anterior, and shorter posterior slope and acute, transverse and broadly excised upper border. Postpetiole twice as broad as the petiolar node, about three times as broad as long, with the sides angularly produced in the middle. Gaster broadly elliptical, nearly as large as the head. Legs long and slender.

Shining throughout; mandibles covered with sparse, rather small punctures. Clypeus smooth in the middle, rugulose on the sides. Anterior fourth of head, with sharp, longitudinal rugæ, denser and coarser on the cheeks and mesial to the frontal carinæ. Frontal area smooth. Remainder of the head with small widely scattered piligerous punctures except over a small area mesial to the eyes where the punctures are much larger and slightly elongate. Thorax and pedicel smooth, except the pleuræ and base of petiole which are rather coarsely and obscurely rugulose, and the upper surface of the postpetiole, which is somewhat granular and coarsely punctate. Gaster smooth.

Hairs yellow, tapering, abundant and rather long on the head, thorax, pedicel and gaster, but shorter on the legs and antennæ. They are longest and most conspicuous on the lower surface of the head.

Piceous brown, thorax and mandibles more ferruginous; basal half of gaster and legs sordid yellow, borders of mandibles black.

Worker. Length: 2–2.2 mm.

Head, excluding the mandibles, barely longer than broad, with rounded posterior corners and rather convex posterior border. Eyes near the middle of the sides. Mandibles with oblique, multidenticulate blades. Clypeus broadly rounded in front, without any trace of a median excision in its anterior border. Frontal area impressed, triangular. Antennæ slender, scapes surpassing the posterior corners of the head by about ¼ their length. Thorax slender. In profile the pro- and mesonotum are angular owing to a transverse ridge representing the straight ridge between the humeri in the soldier. Mesoëpinotal constriction pronounced, base and declivity of epinotum forming an obtuse angle in profile; spines represented only by small angular elevations. Petiole from above oblong, 2½ times as long as broad, node low and rounded; postpetiole oblong, less than twice as broad as the petiole and less than twice as broad as long. Gaster somewhat larger than the head. Legs long and slender.

Glabrous; mandibles opaque, striatopunctate.

Pilosity similar to that of the soldier and also abundant on the lower surface of the head.

Black; gaster, legs and antennæ brown; mandibles, anterior border of clypeus and tarsi dull yellow.

Described from a single soldier and a number of workers taken from a small crater nest on the Mojave desert near Needles, California, close to the boundary of Arizona.

This species is peculiar in the structure of the thorax and petiole of the soldier, especially in the transverse ridge of the pronotum, which is also indicated in the worker. The latter would readily be taken for a *Monomorium* owing to its unarmed epinotum, shining surface and the shape of the pedicel.

65. **Pheidole macclendoni** sp. nov.

(Pl. XXVII, Fig. 36.)

Soldier. Length: 5.5. mm.

Head very large, convex, as broad in front as behind, excluding the mandibles somewhat longer than broad, with straight subparallel sides, deeply and angularly excised posterior border and deep occipital groove. Eyes small, somewhat flattened, ⅓ the distance from the anterior to the posterior corners. Mandibles very convex, with two blunt apical teeth. Clypeus short, flattened, without a median carina and with a deep median notch in the anterior border. Antennæ slender, scape curved, but not flattened at the base, its tip reaching to the posterior orbit; club shorter than the remainder of the funiculus; joints 2–8 nearly 1½ times as long as broad. Frontal area impressed, longitudinally rugose. Frontal carinæ more than ⅓ as long as the antennal scapes. Thorax robust, in front nearly ½ as broad as the head, pronotum transversely swollen between the prominent humeri, mesonotum with a transverse welt or torulus in the middle, bounded in front and behind by a depression. Epinotum with subequal base and declivity and long spines, which are very blunt at their tips and directed upward and slightly outward. Petiole from above violin-shaped, as broad in front as behind, with concave sides and an anteroposteriorly compressed node, broadly and deeply emarginate above. Postpetiole 2½ times as broad as the petiole and about twice as broad as long, with prominent and rather acute lateral conules which are convex both on their anterior and posterior surfaces. Gaster broadly elliptical, flattened, much smaller than the head. Legs long, with incrassated femora.

Shining; mandibles covered with sparse, rather small punctures. Clypeus rather smooth in the middle, rugose on the sides. Head smooth, very sparsely and finely punctate, except the anterior half, which is longitudinally rugose, the rugæ tending to become somewhat reticulate posteriorly. The space between the frontal carinæ is entirely filled with rugæ which extend a little farther back than those on each side of the eyes. Pro- and mesonotum obscurely, transversely rugose above. Meso- and metapleuræ with coarse longitudinal rugæ, the former also finely punctate. Upper surface of epinotum and base of petiole irregularly punctate-rugose. Postpetiole and gaster smooth and shining.

Hairs golden yellow, pointed, erect, abundant and rather long, especially on the thorax, pedicel and gaster; more appressed but long on the legs and antennal scapes.

Ferruginous; borders of mandibles, clypeus and occipital groove black; gaster dark brown; base of first segment and legs, except the femora, brownish yellow.

Worker. Length: 2–2.5 mm.

Head, excluding the mandibles as broad as long, rectangular, with straight posterior and parallel lateral borders, with the eyes a little in front of the middle. Mandibles with several small teeth. Clypeus convex, with a broad and sinuate median excision in its anterior border. Frontal area small, deeply impressed. Antennal scapes extending a short distance beyond the posterior corners of the head. Thorax resembling that of the soldier, but pro- and mesonotum lower, more rounded and with sloping humeri; the mesonotum evenly sloping, without a transverse welt. Base and declivity of epinotum subequal, the former flattened or slightly convex in profile, spines very minute, acute. Petiole oblong, three times as long as broad; with a compressed, rather acute, transverse node which is not notched in the middle. Postpetiole nearly twice as broad as the petiole, as long as broad, with rounded sides. Gaster smaller than the head.

Shining; mandibles subopaque, finely striatopunctate. Sides of head as far back as a little behind the eyes longitudinally rugose and punctate, more opaque than the front, vertex and occiput. Meso- and epinotum subopaque, very finely punctate; the former also with faint transverse rugæ. Petiole subopaque, its node and the postpetiole shining.

Pilosity much like that of the soldier.

Black or very dark brown; legs brown; mandibles, tarsi and articulations of the legs more yellowish.

Intermediates. Length: 3.5–4.5 mm.

These appear to be fairly numerous in the nests of this species. They differ from the soldiers in their much smaller heads which are sometimes only ⅓ to ½ as long, the postpetiole, which is narrower and less angularly produced on the sides, and the epinotal spines which are smaller and acute. The head of the soldier is 2.6 mm. in length, that of the intermediates varies from 1–2 mm.

Texas: Laredo (J. F. McClendon); Corsicana (Miss Mary Cooper).

This ant, which is in all probability a harvester, is readily distinguished from all the other described species of *Pheidole* from the United States by the huge, thick, and largely smooth head of the soldier. The intermediates are readily distinguished from the soldiers of *xerophila* by the different sculpture of the thorax, shape of petiole and the more slender and acute epinotal spines.

66. **Pheidole rhea** sp. nov.

Female (deälated). Length: 14.3 mm.

Head, excluding the mandibles, a little broader than long, broader behind than in front, with prominent and rather sharp posterior corners and broadly and angularly excised posterior border. Occipital groove deep in front and behind the ocelli. Eyes rather large and convex, their posterior orbits a little in front of the middle of the head. Mandibles convex, with strongly deflected tips, and two acute apical teeth. Clypeus flattened in the middle, without a median carina and with a deep narrow notch in the middle of its anterior border. Frontal area deeply impressed, triangular. Frontal carinæ prominent, about half as long as the antennal scapes, which are much curved at their bases, flattened but not dilated, and reaching the posterior orbits with their tips; club much shorter than the remainder of the funiculus; joints 2–8 subequal, distinctly longer than broad; the first joint as long as the two succeeding joints together. Thorax robust, flattened above, not quite as broad through the wing insertions as the head through the posterior corners. Epinotum with its basal surface much shorter than the somewhat concave declivity into which it passes between the spines. The latter are very long, pointed and directed backward and distinctly downward at their tips. Petiole from above a little broader than long, suborbicular, with convex, irregularly rounded sides and without a peduncle. Node with a flattened anterior slope and abrupt, concave posterior slope; the summit compressed anteroposteriorly, rather sharp, deeply, broadly, and angularly notched so that it is really bicornuate. Postpetiole about 1⅔ as broad as the petiole, nearly three times as broad as long, convex and rounded in front, concave behind; the two surfaces meeting to form a transverse ridge which is prolonged on each side into a rather slender, pointed conule. Gaster oblong-elliptical, flattened. Legs rather long and slender.

Mandibles shining, covered with very sparse, elongate punctures or foveolæ, at the extreme base opaque and densely punctate. Clypeus smooth and shining in the middle, transversely and rather finely rugose on the sides. Frontal area shining. Head subopaque, covered throughout with coarse longitudinal rugæ, which diverge towards the posterior corners. On the cheeks and sides of the front the interrugal spaces are punctate-recticulate, on the posterior corners they present coarse, shallow and somewhat elongate foveolæ. Thorax subopaque; pronotum, meso- and metapleuræ covered with sharp, dense, longitudinal rugæ. Mesonotum and scutellum shining, the former smooth and very finely shagreened in the middle, longitudinally rugose and coarsely punctate on the sides. Scutellum with a few coarse piligerous punctures, its posterior border and the paraptera with short coarse parallel striæ. Mesonotum and upper surface of epinotum subopaque, densely punctate-rugulose. Petiole and postpetiole nearly opaque, rather coarsely punctate-rugulose. Gaster shining, entire first segment and posterior portions of remaining segments more densely shagreened or granular and somewhat opaque, base of remaining segments smoother and more shining.

Hairs coarse, brownish yellow, erect, and abundant, especially on the head, antennal scapes and legs.

Black; gaster with a deep reddish tinge at the bases of the second and third segments; tips of antennal scapes, funiculi, trochanters and tarsi dull yellowish red.

Described from a single specimen taken at Nogales, Arizona (Oslar; Cornell University Collection).

This female is of such huge size and presents so many singular characters that I have not hesitated to describe it although the soldier and worker are unknown, for it is too large to be the queen of any of the other described species from the United States except, perhaps, *Ph. titanis*. The color and sculpture of the soldier and worker of this species are, however, very different.

67. **Pheidole vinelandica** *Forel.*

Pheidole bicarinata race *vinelandica* FOREL, Ann. Soc. Ent. Belg., XXX, 1886, C. R. p. xlv, ♃ ☿ ♀ ♂.

Pheidole vinelandica MAYR, Verh. zool. bot. Ges. Wien, XXXVI, 1886, p. 458, ♃; *Ibid.*, XXXVII, 1887, p. 591, ♃, and 606, ☿; DALLA TORRE. Catalog. Hymen., 1893, pp. 97, 98; EMERY, Zool. Jahrb., Abth. f. Syst., VIII, 1894, p. 292, ♃ ☿; FOREL, Ann. Soc. Ent. Belg., XLV, 1901, p. 348, ♃ ☿ ♀ ♂; WHEELER, Bull. Am. Mus. Nat. Hist., XXII, 1906, pp. 336, 337.

Texas: Austin, Marble Falls, Langtry (Wheeler); Paris (Miss Augusta Rucker);

Arizona: Grand Cañon, 3,700 ft. (Wheeler).

Many series of specimens of this species from different parts of the country show that it is hardly distinct from *Ph. bicarinata* Mayr. The soldier of the typical *vinelandica* differs from that of *bicarinata* in having larger frontal carinæ and a transversely rugose instead of a finely punctate epinotum. The Texan specimens of *vinelandica* agree very closely with typical specimens from New Jersey and North Carolina, but specimens from Colorado (Canyon City, Colorado Springs, Boulder) have the epinotum with distinct and often rather coarse transverse rugæ, while the frontal carinæ resemble those of the typical *vinelandica*. This species is highly variable in color, some forms having dark chestnut brown soldiers with nearly black workers, whereas in others the soldiers are reddish yellow and the workers pale brown.

Ph. vinelandica nests in dry, sandy soil fully exposed to the sun's heat and light. Its tiny nest entrances are surrounded by diminutive craters, barely an inch in diameter. Occasionally it is also found nesting under stones.

68. **Pheidole vinelandica** var. **longula** Emery.

EMERY, Zool. Jahrb., Abth. f. Syst., VIII, 1894, p. 292, ☿.

Texas: San Angelo, Alice, Henrietta and Austin (Wheeler); Denton (W. H. Long).

The soldier of this form differs from that of the typical *vinelandica* in its proportionally longer head, with more parallel and less rounded sides and in the sculpture of the epinotum, which has fine but distinct transverse rugæ in addition to the fine punctation. It presents the same color variations as the typical form of the species.

69. **Pheidole vinelandica buccalis** subsp. nov.

The soldier of this form differs from that of the typical *vinelandica* in its somewhat larger size (3.5 mm.), in having a somewhat narrower thorax and in the coloration, which is piceous brown, with the disks of the mandibles and a large spot on each cheek dull orange. The latter is sharply defined against the dark brown border of the head. The chin, posterior corners of the head, pleuræ and appendages are slightly paler than the remainder of the body. The rugæ on the base of the epinotum are rather indistinct. The worker too, is larger and darker than that of the typical *vinelandica,* measuring nearly 2 mm. in length. The female measures 5 mm. and is dark brown and very opaque, with the anterior third of the head, the mandibles, tibiæ, tarsi, tips and bases of the femora dull brown. The hairs on the body are more abundant than in the typical form of the species.

Arizona: Ash Fork; Prescott (Wheeler).

Described from a single deälated female and many soldiers and workers.

70. **Pheidole casta** sp. nov.

(Pl. XXVI, Figs. 22 and 23.)

Soldier. Length: 3.5–3.7 mm.

Head, excluding the mandibles, about 1¾ times as long as broad, flattened, slightly broader in front than behind, with subparallel sides and rather deeply and narrowly excised posterior border. Eyes rather small, flattened, situated about ¼ the distance from the anterior to the posterior corners. Mandibles convex, with two larger apical and two very indistinct basal teeth. Mentum with two acute teeth. Clypeus with a short but prominent carina and a distinct notch in the middle of the anterior border. Frontal area rather large, shallow, with a median carinula. Frontal carinæ prominent but rounded, about ⅓ as long as the antennal scapes, which are short, slender and somewhat curved at their bases, and with slightly thickened tips that extend a little beyond the posterior orbits. Clubs as long as the remainder of the funiculi; joints 2–8 distinctly broader than long. Thorax robust, through the angular humeri about ⅔ as broad as the head. Upper portion of pro- and mesonotum about as broad as long, the latter without a transverse groove, but with an abruptly declivous posterior surface. Basal surface of epinotum a little longer than the declivity, slightly concave. Spines acute, as long as broad at the base, directed upward and slightly outward and continued forward at their bases as sharp ridges. Space between the spines sloping. Petiole from above violin-shaped, a little more than 1½ times as long as broad, with prominent anterior angles. Node anteroposteriorly compressed, with straight, entire upper border. Postpetiole about twice as broad as the petiole, nearly three times as long as broad, with prominent and rather acute conules in the middle of the sides. Gaster elongate elliptical, somewhat larger than the head. Legs short, with incrassated femora and tibiæ.

Shining; mandibles sparsely punctate; clypeus shining in the middle, subopaque and longitudinally rugose on the sides. A little less than the anterior half of the head longitudinally rugose, except in the rather pronounced antennal sulcus. Posterior portion of head sparsely punctate. Epinotum, petiole and postpetiole subopaque, very finely punctate; extreme base of epinotum transversely rugose.

Hairs pale yellow, erect and moderately abundant on the body, short and appressed on the legs and antennæ.

Reddish yellow; antennæ, legs and gaster paler, borders of mandibles, anterior border of clypeus and articulations of antennæ black.

Worker. Length: 1.3–1.5 mm.

Head, excluding the mandibles, rectangular, a little longer than broad, with straight posterior border. Mandibles with two prominent apical and several smaller basal teeth. Eyes moderate, just in front of the middle of the head. Anterior border of clypeus not emarginate in the middle. Antennal scapes reaching to the posterior corners of the head. Thorax rather long, with convex, hemispherical pronotum, and rounded humeri. Mesoëpinotal depression pronounced but narrow. Epinotum with subequal base and declivity. Spines short, acute and erect, their bases prolonged forward as ridges along the sides of the basal surface. Petiole less than half as broad as the epinotum, about twice as long as broad, somewhat broader behind than in front. Node rather compressed in profile, with long, somewhat concave anterior, and short abrupt posterior slope. Postpetiole distinctly broader than long, about twice as broad as the petiole, subcampanulate, with rounded sides. Gaster about the size of the head. Legs rather short.

Shining; mandibles finely and indistinctly punctate, anterior ⅔ of head finely longitudinally rugose and subopaque, more reticulate around the eyes. Epinotum and posterior portion of mesonotum subopaque, evenly and sharply punctate. Petiole and postpetiole opaque on the sides and below. Gaster glabrous.

Pilosity similar to that of the soldier but shorter and less conspicuous.

Brownish yellow, mesonotum somewhat darker, gaster, legs and antennæ paler. Head chestnut brown, with paler mandibles and clypeus. Mandibular teeth black.

Described from several soldiers and workers found in the cañon of the Rio Grande at Langtry, Texas, nesting in the ground under cedars.

This species is related to *Ph. tysoni* Forel of the Atlantic States and to *Ph. subarmata* Mayr and *cornutula* Emery of the American tropics. The head of the soldier is much longer and the humeri more acute than in *tysoni* and the frontal carinæ are not produced into teeth and the clypeus is not entire as in *subarmata* and *cornutula*. The workers of all of these forms are hardly distinguishable; the head of the *casta* worker, however, seems to be more rectangular and less glabrous than in the three species mentioned.

71. **Pheidole humeralis** sp. nov.

(Pl. XXVII, Fig. 39.)

Soldier. Length: 3–3.3 mm.

Head large, suboblong, excluding the mandibles 1½ times as long as broad, slightly narrower behind than in front, with sharp anterior angles, broadly and angularly excised posterior border and pronounced occipital groove. Eyes small, about ¼ the distance from the anterior to the posterior corners. Mandibles very convex, without distinct apical teeth. Clypeus short, flattened in the middle, with broadly excised anterior margin. Frontal area elliptical, deeply impressed, with a median carinula. Antennæ short, scapes reaching to the eyes, slender, curved at their bases, joints 2–8 of the funiculus small, about as long as broad, subequal. Frontal carinæ nearly as long as the antennal scapes. Thorax through the humeri, which are very broad and angular, about half as broad as the head. Pronotum from above trapezoidal; in profile somewhat angularly convex in the middle and in the mesonotal region. Mesoëpinotal constriction pronounced. Epinotum in profile with subequal base and declivity, the former horizontal, the latter sloping. Spines robust, long and blunt at the tips, directed outward and backward. Between them the base and declivity are confluent in a narrow groove in the middle. Petiole from above violin-shaped, 1⅔ times as long as broad, broader behind than in front, with pronounced anterior angles. Node not compressed anteroposteriorly, except at the summit, which is transverse and only faintly excised in the middle when seen from behind. Postpetiole 1½ times as broad as the petiole and fully twice as broad as long, with indistinctly angular sides. Gaster elliptical, flattened, about as large as the head. Legs of moderate length.

Smooth and shining; mandibles coarsely punctate; clypeus smooth in the middle, longitudinally rugose on the sides. Anterior half of the head with sharp longitudinal rugæ, which extend only about half as far back between the frontal carinæ as on the sides of the head. Shining posterior half of head with distinct scattered punctures. Thorax glabrous, except meso- and metapleuræ which are subopaque and obscurely punctate-rugose. Petiole and postpetiole shining above, opaque on the sides and below. Gaster glabrous.

Hairs yellowish, suberect or reclinate, long and abundant, especially on the gaster, shorter on the antennal scapes and legs.

Ferruginous; borders of mandibles, anterior border of clypeus, postpetiole and gaster dark brown or black; clubs of antennæ, and frontal carinæ and petiole brown, legs in some specimens yellowish.

Worker. Length: 1.8–2 mm.

Head, excluding the mandibles, but little longer than broad, with an angularly excised posterior margin and pronounced but very short occipital groove. Eyes moderate, flattened, just in front of the middle of the head. Mandibles with several minute and acute denticles of which the apical are scarcely larger than the basal.

Clypeus with a broad but feeble excision in its anterior border. Antennal scapes reaching to the posterior corners of the head. Humeral angles of thorax rounded, not prominent as in the soldier. Upper surface of mesonotum moderately and evenly rounded. Epinotum similar to that of the soldier; spines well-developed, acute. Petiole more than twice as long as broad, but little broader behind than in front; node rather thick, with long, slightly concave anterior slope, short abrupt posterior slope, and rounded summit. Postpetiole but little broader than the petiole, slightly broader than long, with rounded sides. Gaster somewhat smaller than the head, with straight anterior border. Legs rather slender.

Smooth and shining; mandibles coarsely punctate towards their tips, striated at the base. Sides of front, cheeks and regions about the eyes finely longitudinally rugose. Remainder of head and the mesonotum with small, very sparse piligerous punctures. Meso- and epinotum, sides and ventral portions of petiole and postpetiole, densely punctate or reticulate. Gaster glabrous, very sparsely punctate.

Pilosity like that of the soldier but somewhat sparser, conspicuous and suberect on the antennal scapes and legs as well as on the body.

Black or very dark brown; mandibles, antennæ, coxæ, tarsi, tips and bases of the femora and tibiæ yellowish. Antennal clubs, and scapes except their tips, clypeus and anterior corners of head, brown.

Described from several soldiers and workers taken by Miss Mary Cooper at Corsicana, Texas.

This species is quite distinct in the peculiar structure of the thorax of the soldier. In this respect it resembles *Ph. barbata* but is much smaller and the head is proportionally longer, the postpetiole narrower, with less angular sides and the gaster smaller. The workers of the two species are also very different, that of *barbata* having much longer and more slender legs and antennæ and lacking the occipital groove and the spines on the epinotum.

72. **Pheidole marcidula** sp. nov.

Soldier. Length: 2.5 mm.

Head, excluding the mandibles, about ¼ longer than broad, slightly broader in front than behind, with slightly bulging sides, angularly excised posterior margin and deep occipital groove. Eyes moderate, a little less than ⅓ the distance from the anterior to the posterior corners. Mandibles convex, with two stout apical teeth. Clypeus short, rather deeply impressed in the middle, with broadly excised anterior margin. Frontal carinæ very short; frontal area triangular, rather shallow, with a median and two lateral carinulæ. Antennæ slender, scapes reaching to a little beyond the eyes. Club a little shorter than the remainder of the funiculus. Funicular joints 2–8 fully as long as broad. Thorax robust, less than half as broad as the head, humeri prominent but rounded, mesonotum longer than broad in profile, convex in the middle, but anteriorly and posteriorly somewhat flattened. Mesoëpinotal constriction rather broad and shallow. Epinotum with subequal base and declivity and blunt spines, which are less than half as long as their bases, directed upward and slightly outward. Petiole somewhat violin-shaped, about twice as long as broad, and a little broader behind than in front; node compressed anteroposteriorly. Postpetiole less than twice as broad as the petiole, 1½ times as broad as long, with blunt but distinct lateral angles in front of the middle. Gaster conspicuously smaller than the head. Legs rather slender.

Head and gaster shining; thorax, petiole and postpetiole nearly opaque. Mandibles covered with coarse, sparse punctures. Clypeus smooth in the middle, very finely striated on the sides. Cheeks and front traversed by sharp, but not very coarse, longitudinal rugæ, some of which extend back in the occipital groove and meet a series of transverse rugæ which are confined to the bottom of this groove and the adjacent region in front, but lengthen and extend out posteriorly onto the occipital lobes where they disappear. Thorax and pedicel very finely rugulose-punctate, mesonotum slightly smooth and shining above.

Hairs pale yellow, moderately abundant, suberect, shorter on the legs and antennæ, somewhat obtuse on the gaster.

Yellow; the head and antennal clubs a little more reddish; the mandibles and clypeus reddish brown, the former bordered with black.

Worker. Length: 1.3–1.5 mm.

Head, excluding the mandibles, a little longer than broad, with distinctly and angularly excised posterior border. Eyes rather large, convex, just in front of the middle of the head. Mandibles with larger apical and smaller basal teeth. Clypeus convex, with the anterior border narrowly excised in the middle. Antennal scapes nearly reaching the posterior corners of the head. Mesonotum evenly rounded above. Mesoëpinotal impression distinct. Epinotum with subequal base and declivity. Spines as long as broad at their bases, acute, flattened, directed outward, upward and backward. Petiole nearly three times as long as broad, hardly broader behind than in front, sides slightly concave at the middle, node compressed anteroposteriorly, with entire upper border. Postpetiole a little broader than the petiole and a little broader than long, subglobular. Gaster smaller than the head. Legs rather long.

Smooth and shining; mandibles subopaque, finely striatopunctate. Cheeks and front with only a few indistinct longitudinal rugæ. Meso- and epinotum, sides and ventral surfaces of petiole and postpetiole subopaque, finely and densely punctate.

Hairs very sparse, suberect on the body, pointed on the head, clavate and obtuse on the remainder of the trunk, but especially on the thorax, petiole and postpetiole, where they are arranged in pairs somewhat as in *Leptothorax* workers. Hairs on antennæ and legs shorter denser and appressed.

Yellow; legs somewhat whitish; mandibular teeth and corners of clypeus reddish.

Described from a single soldier and seven workers taken from a small colony under a stone at Barton Creek near Austin, Texas.

This species is related to *vinelandica* but the sculpturing of the head in the soldier and worker is much less extensive, the mesonotum of the soldier is much longer and narrower, and the pilosity of the worker is very different.

73. **Pheidole pinealis** sp. nov.

(Pl. XXVII, Fig. 38.)

Soldier. Length: 3.2–3.5 mm.

Head large, excluding the mandibles, about ¼ longer than broad, as broad in front as behind, with subparallel sides, angularly excised posterior margin and deep occipital groove extending forward as far as the frontal area. Eyes rather small, convex, about ⅓ the distance from the anterior to the posterior corners of the head. Mandibles convex, with two stout apical teeth. Clypeus flattened in the middle behind, impressed in front, with a distinctly excised anterior border. Antennæ well-developed, scapes reaching to a little beyond the eyes. Club somewhat shorter than the remainder of the funiculus; joints 2–8 as long as broad. Frontal carinæ about ½ as long as the antennal scapes. Frontal area shallow, triangular, with a median carinula. Thorax, robust, about half as broad as the head. Mesonotum as broad as long, with prominent humeri. Epinotum with subequal base and declivity, the latter sloping. Spines longer than broad at the base, very acute, directed upward and slightly outward and backward. Petiole nearly twice as long as broad, somewhat violin-shaped, but little broader behind than in front; node high, much compressed anteroposteriorly, with rather sharp upper border distinctly excised in the middle. Postpetiole nearly three times as broad as the petiole and three times as broad as long, with prominent, rather acute lateral conules. Gaster broadly elliptical, smaller than the head. Legs of moderate length.

Smooth and shining; mandibles coarsely and sparsely punctate. Clypeus irregularly rugulose in the middle, longitudinally rugose on the sides. Anterior third of head coarsely rugose, posterior ⅔ with coarse and sparse piligerous punctures. Mesonotum between the humeri with sharp transverse rugæ. Entire epinotum densely punctate, pleuræ and ventral portions of petiole and postpetiole indistinctly rugulose. Gaster with small, scattered, piligerous punctures.

Hairs yellowish, coarse, and rather abundant, suberect; shorter and more reclinate on the antennal scapes and legs than on the body.

Ferruginous brown; head, pronotum, pleuræ and legs more yellowish; borders of mandibles, anterior border of clypeus and a sharply defined sagittate blotch on the middle of the head, dark brown or black.

Worker. Length: 1.3 mm.

Head, excluding the mandibles, nearly as broad as long, subrectangular, with angularly excised posterior border. Eyes moderately large, convex, a little in front of the middle of the head. Mandibles with two larger apical and several small basal teeth. Clypeus with feebly excised anterior border. Antennal scapes reaching a little beyond the posterior corners of the head. Mesonotum rounded, without prominent humeri. Epinotum similar to that of the soldier. Petiole about twice as long as broad, scarcely broader behind than in front, with concave sides and compressed node, the transverse upper border of which is not excised in the middle. Postpetiole about half again as broad as the petiole, somewhat broader than long, with rounded sides. Gaster about the size of the head. Legs moderate.

Smooth and shining; mandibles striatopunctate; cheeks and front of head longitudinally rugose. Mesopleuræ, epinotum and ventral portions of petiole and postpetiole opaque, densely punctate. Hairs similar to those of the soldier, but less abundant. Brown; gaster darker, mandibles yellowish.

Described from eleven soldiers and a single worker taken from a nest under a stone in Limpio Cañon about 10 miles west of Fort Davis, Texas. The chambers of the nest were stored with large seeds.

This species is very closely related to *Ph. vinelandica* but the soldier has a larger head, prominent pointed conules on the postpetiole and a black spot on the vertex. The worker *pinealis*, judging from the single specimen I have seen, is much less pilose and of a more uniform color than that of *vinelandica.*

74. **Pheidole desertorum** *Wheeler.*

Wheeler, Bull. Am. Nat. Hist., XXII, 1906, pp. 337–339, ♃ ☿ ♀ ♂.

Texas: Ft. Davis. (Wheeler).
Arizona: Ash Fork, Prescott, Phoenix, and Tuscon (Wheeler).

75. **Pheidole desertorum** var. **comanche** *Wheeler.*

Wheeler, Bull. Am. Mus. Nat. Hist., XXII, 1906, p. 339, ♃ ☿.

Texas: Paisono Pass and Terlingua (Wheeler).

76. **Pheidole desertorum** var. **maricopa** *Wheeler.*

Wheeler, Bull. Am. Mus. Nat. Hist., XXII, 1906, pp. 339, 340, ♃ ☿.

Arizona: Grand Cañon, 3876 ft. (Wheeler).

77. **Pheidole dentata** *Mayr.* var. **commutata** *Mayr.*

Pheidole commutata Mayr, Verh. zool. bot. Ges. Wien, XXXVI, 1866, p. 459, ♃ ☿; Mayr, *Ibid.*, XXXVII, 1887, p. 598, ♃, 604, ☿; Dalla Torre, Catalog. Hymen., VII, 1893, p. 93; Emery, Zool. Jahrb., Abth. f. Syst., VIII, 1894, p. 295.

Pheidole dentata subsp. or var. *commutata* Forel, Ann. Soc. Ent. Belg., XLV, 1901, p. 352.

Pheidole dentata var. *commutata* Wheeler, Bull. Am. Mus. Nat. Hist., XII, 1907, p. 18, pl. iii, figs. 37–40.

Texas: Laredo (J. F. McClendon); Hearne, Denton and Meridian (W. H. Long); New Braunfels, Austin, Galveston, Alice and Granite Mt. (Wheeler). Also in Florida and Missouri.

I quite agree with Forel that this form is not specifically distinct from Mayr's *dentata* and that this in turn should not be regarded as a variety of *morrisi* but as an independent species. As Mayr observed, the soldiers of *commutata* are highly variable in color even in the same colony, some being nearly black, while others are red, with a brown or black gaster. The workers, too, vary in a similar manner. The females are rich red, with a broad, dark brown band across each gastric segment. The antennal scapes of this sex are distinctly but very slightly flattened and dilated at their curved bases, though this is not the case in the soldiers. *Ph. commutata* is perhaps the most abundant *Pheidole* in Central Texas where it nests under stones or in and under old logs, or makes untidy fused craters with many openings about the roots of trees or other plants. It is a highly carnivorous species with no tendency to harvest seeds. Forel's *Ph. dentata* var. *faisonica* from North Carolina is hardly distinct from the Texas and Florida form.

78. **Pheidole morrisi** *Forel* var. **impexa** var. nov.

(Pl. XXVII, Fig. 31.)

Texas: Del Valle near Austin (Wheeler).

A deälated female, a male and several soldiers and workers, taken from a compact crater nest about 5 inches in diameter in pure sand, differ sufficiently from typical specimens from North Carolina to be regarded as a distinct variety. The soldier and worker are much more hairy and the anterior portion of the head of the former is much more coarsely rugose. In the female there are no dark blotches on the head and mesonotum and the dark brown color of the gaster is confined to a narrow band across the posterior portion of each segment. The male is pale yellow throughout, with only the posterior two thirds of the head infuscated. The male of the variety *vanceæ* Forel of North Carolina has the thorax brown above and the wings have somewhat darker veins than *impexa*. The males of the typical form from the sandy pine barrens of Lakehurst, New Jersey, are black, with slightly infuscated wings and brown veins. I am unable to distinguish the soldiers, workers and females of this form from North Carolina specimens received from Forel. This author describes the males among his specimens as "sordid yellowish testaceous, with the upper surface of the head brownish." The types of this species are from Vineland, New Jersey. In the females of all the forms of *morrisi* the antennal scapes are distinctly dilated and flattened at the base.

79. **Pheidole titanis** *Wheeler*.

(Pl. XXVII, Fig. 30.)

WHEELER, Psyche, June, 1903, pp. 95–97, ♃ ☿.

Texas: Chisos Mts. (O. W. Williams); Paisano Pass (Wheeler).

This and *Ph. rhea* are the largest species known to occur in the United States and are among the largest of the genus.

80. **Pheidole hyatti** Emery.

(Pl. XXVII, Fig. 32.)

Emery, Zool. Jahrb., Abth. f. Syst., VIII, 1894, pp. 295–296, ♃ ☿.

Soldier. Length: 4–4.5 mm.

Head rather small, excluding the mandibles about as broad as long, as broad behind as in front, with angularly excised posterior border, deep occipital furrow and rounded posterior lobes; sides slightly convex. Eyes rather large, somewhat convex, ⅓ the distance from the anterior to the posterior corners. Mandibles not very convex, with two stout apical and several small basal teeth. Clypeus flattened and indistinctly carinate in the middle, with a pronounced excision in the anterior border. Antennal scapes reaching nearly to the posterior corners of the head, distinctly dilated and flattened at their curved bases and of nearly equal diameter throughout. Club somewhat shorter than the remainder of the funiculus; funicular joints 2–8 considerably longer than broad. Frontal carinæ prominent, about half as long as the antennal scapes. Frontal area triangular, rather deep, with a median carinula. Thorax in front with prominent but rounded humeri, half as broad as the head. Pronotum rounded above, mesonotum rounded anteriorly, transversely impressed in the middle and angular behind. Mesoëpinotal constriction deep. Epinotum with the base slightly longer than the declivity, the former narrowly grooved in the middle, the latter somewhat concave. Spines moderate, acute, as long as broad at the base, directed upward and slightly backward and outward. Petiole violin-shaped, nearly twice as long as broad, a little broader behind than in front, with concave sides. Node but little compressed anteroposteriorly, rounded and blunt above, without a median excision. Postpetiole less than twice as broad as the petiole, about twice as broad as long, broader in front than behind, with rounded sides. Gaster somewhat smaller than the head. Legs rather slender.

Mandibles smooth and shining, sparsely punctate, except at the base where they are longitudinally striated. Middle of clypeus and front and posterior corners of the head shining; remaining portions of clypeus and head subopaque, sides of clypeus longitudinally rugose. Portions of head lateral to the frontal carinæ reticulate-rugose, with a general longitudinal trend to the rugæ and punctate interstices on the middle of the head. The rugæ subside more and more and the punctures remain, but in turn become finer and disappear on the shining posterior corners. Occipital furrow transversely crenate. Thorax, petiole and postpetiole subopaque, finely and densely punctate, except the upper surface of the pro- and mesonotum, which is smooth and shining. Gaster shining, finely shagreened.

Hairs yellow, coarse and erect both on the body and appendages, rather abundant and of unequal length, especially on the gaster.

Ferruginous; legs more yellowish, gaster brownish, teeth of mandibles and anterior border of clypeus black.

Worker. Length: 2.5–3 mm.

Head, excluding the mandibles, longer than broad, elliptical, rounded behind. Eyes large, convex, just in front of the middle. Mandibles with two longer apical and several smaller basal teeth. Clypeus flattened, with its anterior margin nearly straight. Antennæ slender; scapes surpassing the posterior corners of the head by more than ⅓ of their length, slender and not dilated or much curved at the base, somewhat enlarged distally; joints 2–8 of the funiculus fully twice as long as broad. Thorax long, resembling that of the soldier, but the promesonotal region is more rounded on the sides. Petiole more than twice as long as broad, resembling that of the soldier, postpetiole but little broader than the petiole, as long as broad, subglobular. Gaster about the size of the head. Legs long and slender.

Shining; mandibles striatopunctate; cheeks and sides of front finely and longitudinally rugose. Sides of pro- and mesonotum, the whole epinotum, petiole and postpetiole subopaque, finely and densely punctate.

Pilosity and color as in the soldier.

Female. Length: 6.5–7 mm.

Head, excluding the mandibles broader than long and broader behind than in front. Posterior margin but little excised, occipital groove shallow. Eyes large, in front of the middle of the head. Mandibles and clypeus as in the soldier. Antennal scapes more dilated and flattened at their curved bases. Thorax through the insertion of the fore wings distinctly broader than the head. Epinotal spines short and acute, with very broad bases. Petiole and postpetiole similar to those of the soldier, but the former segment with a higher and sharper node, distinctly excised in the middle. Wings very long (8 mm.).

Mandibles shining, coarsely punctate, with fine striæ at the base. Clypeus smooth and shining in the middle, rugulose on the sides. Head subopaque, reticulate-rugose even on the posterior corners, but the front is smoother and has only a few longitudinal rugæ on each side near the carinæ. Thorax somewhat shining, especially above, mesonotum finely striated and coarsely punctate, smooth and shining in front. Paraptera and scutellum with smaller, scattered punctures. Pleuræ indistinctly, epinotum much more coarsely reticulate-rugulose, as are also the petiole and postpetiole. Gaster shining, distinctly shagreened.

Hairs similar to those of the soldier but proportionally shorter.

Head, thorax and appendages yellowish ferruginous; petiole, postpetiole and gaster brown. Teeth of mandibles and anterior border of clypeus dark brown. Wings yellowish hyaline, with yellow veins and stigma.

Texas: San Angelo, Marfa, Ft. Davis, Paisano Pass (Wheeler).
California: Catalina (C. F. Baker); San Jacinto (Pergande, Emery).
Mexico: Chihuahua (C. H. T. Townsend); Cuernavaca (Wheeler).

81. **Pheidole hyatti** var. **ecitonodora** var. nov.

Texas: Austin and Belton (Wheeler); Paris (Miss Rucker).
New Mexico: Las Truches (Miss L. Gerhardt).
Colorado: Cañon City (Schmitt); Colorado City (Wheeler).

This is the common form in Texas and New Mexico and differs from the preceding in the darker coloration of the soldier, worker and female, which have the gaster black. Often, too, the whole body of the soldier and worker is dark brown or black, with somewhat paler legs and antennæ. In the female the wings seem to be shorter (7 mm.), at least in the Texan specimens. The soldiers have the rank fecal odor of *Eciton* workers. The male measures 4–4.5 mm. and is sordid yellow or light brown, with dark brown head and gaster and tridentate mandibles. Like the typical form of the species this variety lives in populous colonies under stones and is highly predacious. Sometimes more than a dozen deälated females may be found in a single nest.

82. **Pheidole texana** *Wheeler.*

(Pl. XXVII, Figs. 33 and 34.)

Wheeler, Psyche, June, 1903, pp. 97–99, ♃ ☿.

Texas: Travis County.

Allied to *Ph. hyatti* but easily distinguished by the heavy reticulate sculpturing of the head, thorax, petiole and postpetiole in both soldier and worker. The antennal scapes of the soldier reach nearly half way between the eyes and the posterior corners of the head.

83. **Pheidole cockerelli** sp. nov.

Soldier. Length: 4–5 mm.

Head rather small, excluding the mandibles a little longer than broad, as broad in front as behind, with deeply and angularly excised posterior border and narrow but well-developed occipital groove. Sides slightly rounded, with the rather large, moderately convex eyes at the anterior third. Mandibles not very convex, with two strong apical, but no basal teeth. Clypeus faintly carinate in the middle, with a pronounced notch in the anterior border. Antennal scapes flattened and curved at the base, reaching to half way between the eyes and posterior corners of the head; funicular joints 2–8 a little longer than wide. Frontal carinæ prominent, about ⅓ as long as the antennal scapes. Frontal area triangular, impressed, carinulate. Thorax in front half as broad as the head, with somewhat rounded humeri. Pronotum and base of mesonotum convex above, the latter with a transverse depression in the middle and a distinct torus. Mesoëpinotal constriction prominent. Epinotal base longer than the declivity, the former grooved in the middle. Spines slender, acute, ⅓ as long as the base of the epinotum, directed upward and slightly backward and outward. Petiole violin-shaped, a little more than twice as long as broad, with concave sides; node somewhat compressed anteroposteriorly, with a slightly excised upper margin. Postpetiole less than twice as broad as the petiole and less than twice as broad as long, with rounded scarcely angulated sides. Gaster as large as the head. Legs rather slender.

Mandibles and clypeus shining, the former coarsely punctate and towards the base coarsely striate; the latter with delicate, rather sparse rugæ even on the middle. Head subopaque, only the frontal area and a triangular region immediately behind it smooth and shining, the remainder of the head densely punctate and reticulate-rugose, the sides of the front longitudinally rugose. The posterior portion also with some coarse shallow foveolæ. Thorax, petiole and postpetiole subopaque, and densely punctate, the upper surface of the pro- and mesonotum somewhat shining and transversely rugulose. Gaster shining, distinctly shagreened throughout, with scattered piligerous punctures.

Hairs brownish yellow, acute, suberect, on body, scapes and legs; rather short but moderately abundant.

Deep ferruginous red; gaster, mandibular teeth, anterior border of clypeus and bases of antennal scapes, black.

Worker. Length: 2.6–3 mm.

Head, excluding the mandibles, longer than broad, rounded behind, with large convex eyes just in front of the middle. Mandibles with two large apical and several smaller basal teeth. Clypeus convex, with faintly notched anterior border. Antennal scapes slender, somewhat enlarged distally, not curved nor flattened at the base, surpassing the posterior margin of the head by nearly ⅓ their length; funiculus similar to that of the soldier but more slender. Thorax like that of the worker, but with more sloping humeri and less angular mesonotum. Petiole nearly three times as long as broad; node high, somewhat compressed, with convex upper border. Postpetiole half again as broad as the petiole, a little broader than long, subglobular. Gaster about as large as the head. Legs slender.

Mandibles subopaque, finely striated and punctate. Clypeus and front shining, remainder of head opaque, densely punctate, cheeks reticulate-rugose. Thorax, petiole and postpetiole opaque and densely punctate, middle of pronotum and the petiolar and postpetiolar nodes smooth and shining. Gaster glabrous.

Pilosity similar to that of the soldier.

Thorax, pedicel and appendages deep ferruginous brown; head and gaster black, mandibles brownish yellow, with black teeth.

New Mexico: Arroyo Pecos, Las Vegas (T. D. A. Cockerell).

Arizona: Prescott (Cockerell, Wheeler); Tempe (F. H. Simmons).

This species may be best described as half way between *Ph. hyatti* and *texana*. The sculpture of the head of the soldier is coarser than that of *hyatti* but much finer than that of *texana*, although as in the latter species it covers the whole occipital portion. The thorax and pedicel are much less robust than in *texana*, the epinotal spines are more acute, the antennal scapes longer and less flattened and the color is darker. The worker *texana* is easily distinguished from that of *cockerelli* by its much rougher sculpture, the hinder portions of the head being reticulately rugose, and the much larger postpetiole and lighter color.

84. **Pheidole crassicornis porcula** subsp. nov.

(Pl. XXVII, Fig. 35.)

Soldier. Length: 4.5–5 mm.

Head with the posterior angles more rounded than in the typical *crassicornis*, excluding the mandibles as broad as long. Mandibles with two large apical, and several small basal teeth. Clypeus concave and distinctly carinate in the middle, with a median notch in its anterior border. Antennal scapes very much flattened and curved at the base, their tips reaching to ½ the distance between the eyes and the posterior corners of the head; joints 2–8 of funiculus cylindrical, longer than broad. Frontal carinæ high, about ¼ as long as the antennal scapes. Frontal area deeply impressed, triangular, with a median carinula. Thorax and pedicel robust, very similar to those of the typical form. Gaster elliptical, flattened, distinctly smaller than the head. Legs rather robust.

Mandibles shining, coarsely punctate and somewhat striated at the base on the outer side. Clypeus shining, smooth in the middle, irregularly rugulose on the sides. Sculpture of head like that of the typical *crassicornis*, except that the posterior portion is more opaque and has scattered shallow foveolæ. Thorax and gaster shining and subopaque, epinotum, petiole and postpetiole opaque, finely and densely punctate.

Hairs pale yellow, coarse, acute, rather long, abundant, erect on the body scapes and legs, almost absent on the upper surface of the gaster. Pubescence lacking.

Head, thorax, legs and antennæ brownish yellow, border of mandibles and clypeus blackish, pedicel and gaster brown.

Worker. Length: 2.25–2.5 mm.

Differing from the worker of the typical *crassicornis* in having the head in front and behind the eyes shining, with scarcely perceptible scattered punctures, the epinotal spines reduced to mere acute denticles and the body of a deeper color. Head and gaster dark brown or almost black. The pilosity is like that of the typical form, there being some erect hairs on the antennal scapes, legs and body but differing in the absence of hairs on the upper surface of the gaster.

Described from several soldiers and workers from a single colony found by Judge O. W. Williams under a stone in the Chisos Mts. Texas.

Were it not for the existence of the next variety I should regard *porcula* as a distinct species on account of its larger size, more flattened scapes, erect pilosity, absence of pubescence on the head and gaster, foveolation of the hind part of the head in the soldier, and the very different sculpture and short epinotal spines of the worker. The next variety, however, is clearly transitional to the typical form from North Carolina, which has the body and appendages singularly devoid of hairs and only a very sparse though distinct pubescence on the head and gaster in the soldier.

85. **Pheidole crassicornis porcula** var. **tetra** var. nov.

The soldier of this variety closely resembles the typical *crassicornis* in the size and in the sculpture of the head, which is very smooth and shining behind, with a few small piligerous punctures. The pilosity is much denser than that of *porcula* on the thorax, pedicel and gaster, and covers the whole upper surface of the gaster. The erect hairs on the antennal scapes are few but distinct and confined to the anterior border; on the legs they are often as abundant as in the typical *porcula*. The longer hairs on the thorax, pedicel and gaster in specimens from some colonies are distinctly obtuse. The head, but not the gaster, has the long, very sparse punctures of the typical *crassicornis*. The mandibles are more finely punctate, the clypeus more opaque than in *porcula*.

The worker of *tetra* has a distinctly and finely punctate head which, however, is much more shining on the sides and behind than in the typical form of the species. The epinotal spines are as long and robust, the color is darker like that of *porcula*.

Described from numerous soldiers and workers taken from five colonies at San Antonio and Austin, Texas. Although there are minor differences in the abundance and obtuseness of the hairs among specimens from different nests, I deem it advisable to erect only one other variety, as it is clear that *crassicornis* is a protean form in respect to pilosity and sculpture and cannot be satisfactorily elucidated without an examination of much more material. The species is not a very common one according to my observations.

86. **Pheidole crassicornis** var. **diversipilosa** var. nov.

Soldiers, workers and females from two colonies taken at Fort Davis, Texas (June 9, '02) approach the typical *crassicornis* still more closely than the last. In the soldier the head and appendages have only sparse, appressed pubescence, with a few short hairs on the vertex. The hairs on the thorax and pedicel are long, erect but not very abundant, whereas the gaster is covered with numerous short, erect hairs which might best be described as the erected and somewhat lengthened pubescence of the typical form. The color of the soldier is dark reddish brown, the gaster nearly black. In the worker the head and pronotum are smooth and shining, much as in the typical *porcula*, but the epinotal spines are intermediate between those of this subspecies and the typical *crassicornis*.

The female measures 6.3 mm. The antennal scapes resemble those of the soldier but extend to half way between the eyes and posterior corners of the head. The latter and the vertex are shining, sparsely and coarsely punctate. The mesonotum, paraptera, scutellum and gaster are smooth and shining, without sculpture. The epinotum, petiole and post-petiole are subopaque and finely shagreened or punctate. The pilosity is very poorly developed, there being merely a few erect hairs on the thorax and a row of sparse hairs along the edge of each gastric segment. The pubescence is very dilute and rather uniformly distributed over the head, thorax and gaster. Head, thorax, and appendages rich yellowish red, pedicel darker; gaster, ocellar triangle, borders of mandibles and clypeus black. Wings long (8 mm.), hyaline, with honey yellow veins and stigma.

87. **Pheidole constipata** sp. nov.

Soldier. Length: 2.5–2.7 mm.

Head, excluding the mandibles, longer than broad, distinctly narrower in front than behind, with rounded posterior angles, and rather shallow occipital excision and groove; in profile regularly convex above and below, with short but distinct teeth on the mentum. Eyes moderate, less than ⅓ the distance from the anterior to the posterior corners. Mandibles rather convex, with two large apical teeth. Clypeus flattened in the middle, with broad, shallow excision in its anterior border. Antennal scape reaching to ⅓ the distance between the eye and the posterior corner; club as long as the remainder of the funiculus: joints 2–8 of the latter distinctly broader than long. On each side the frontal carina is continued back as a ridge more than half as long as the scape, forming the mesial border of a distinct antennal sulcus. Frontal area deeply impressed, subtriangular, carinulate. Thorax robust, in front fully half as broad as the head, with well-developed but not acutely angular humeri. Anterior surface of mesonotum somewhat flattened, continuous with the pronotum and forming a rather abrupt angle with the posterior slope. Mesoëpinotal constriction pronounced. Epinotum in profile with the base distinctly longer than the declivity, spines blunt and robust, fully half as long as the diameter of the bases, with their anterior and posterior edges continued as ridges bounding the sloping and flattened portion of the ëpinotum. They are as long as the distance between their bases and are directed upward, backward and outward. Petiole 1⅔ as long as broad, but little broader behind than in front, with slightly concave, sides and a high anteroposteriorly compressed node, which is rather thick above, with transverse border and concave posterior surface. Postpetiole about twice as broad as the petiole and about twice as broad as long, with the sides produced into blunt conules at the middle. Gaster much smaller than the head, elliptical, with straight anterior border. Legs rather robust.

Mandibles and clypeus shining, the former with a few coarse punctures, the latter smooth in the middle, longitudinally rugose on the sides. Head subopaque, very finely and densely punctate, cheeks and region between the frontal carinæ also longitudinally rugose; extreme posterior corners and frontal area glabrous and shining. Thorax and petiole opaque, finely and densely punctate. Postpetiole finely punctate but shining above. Gaster shining throughout, obscurely shagreened.

Hairs on the body pale yellow, short, erect, obtuse and not very abundant; on the legs and antennæ very short and appressed.

Ferruginous; head somewhat darker than the thorax, legs and antennæ; borders of mandibles black, antennal clubs and posterior portion of gaster fuscous.

Worker. Length: 1.5–1.7 mm.

Head, excluding the mandibles, a little longer than broad, subrectangular. Eyes prominent, at the anterior third of the head. Mandibles with two large apical and a few small basal teeth. Clypeus convex, with a pronounced notch in the middle of the anterior border. Antennal scapes reaching to the posterior corners of the head. Frontal carinæ very short; frontal area impressed, subtriangular, carinulate. Thorax similar to that of the soldier, but narrower in front and with much less prominent humeri. Epinotal spines acute, longer than broad at their bases, about ½ as long as the base of the epinotum, directed backward and outward and but little upward. Petiole about twice as long as broad, similar to that of the soldier. Postpetiole 1½ times as broad as the petiole, a little broader than long, with blunt median angles on the sides. Gaster ovate, flattened, slightly smaller than the head. Legs rather robust.

Mandibles, clypeus and frontal area somewhat shining, the first striatopunctate. Head, thorax, petiole and postpetiole opaque, densely punctate throughout. Gaster and legs shining.

Hairs similar to those of the soldier but sparser both on the body and appendages.

Ferruginous; upper surface of head, antennal clubs, petiole, postpetiole, gaster and femora more or less infuscated, as are also the epinotal spines. In some specimens the upper surface of the thorax is also very slightly infuscated on the projecting surfaces.

Female. Length: 4.5 mm.

Head, excluding the mandibles, but little longer than broad, broader behind than in front, with angular posterior corners and nearly straight posterior border. Clypeal notch deeper than in the soldier, frontal carinæ longer. Thorax of the usual shape, through the wing insertions a little narrower than the head. Epinotum with shorter base than declivity and robust spines, which are somewhat longer than broad at their bases. Petiole resembling that of the soldier but relatively shorter. Postpetiole large, fully 2½ times as broad as the petiole, with very blunt but well-developed, median conules on the sides. Gaster elongate elliptical, with somewhat concave anterior border.

Mandibles and clypeus similar to those of the soldier, but somewhat shining. Head opaque and densely punctate throughout, longitudinally rugose even on the sides, posterior corners and occiput more reticulate-rugose. There is a shining depression in front of the anterior ocellus. Thorax subopaque and coarsely punctate, mesonotum, paraptera and scutellum shining, all three of these regions with a few foveolæ on the sides, the mesonotum longitudinally striate in the middle behind. Petiole and epinotum uniformly and densely reticulate-punctate, nearly opaque. Postpetiole more shining, with finer, sparser punctures and a few large foveolæ. Gaster shining, finely and indistinctly shagreened, with coarse piligerous punctures.

Hairs sordid yellow, long, tapering, abundant and suberect over the whole body, somewhat shorter but also suberect on the legs and antennal scapes.

Ferruginous; edges of mandibles, ocellar triangle, antennal clubs and sometimes an indistinct spot on the middle of the mesonotum, fuscous. Wing insertions and gaster black, more or less of the base of the first segment of the latter ferruginous. Legs yellowish. Wings hyaline, with dilute yellow veins and stigma.

Male. Length: 2.6 mm.

Head, including the large eyes, as long as broad, without cheeks but produced behind the eyes. Mandibles small, tridentate, barely overlapping with their tips. Antennæ rather short; scape as long as two basal funicular joints taken together; first funicular joint globose, nearly as broad as long, remaining joints cylindrical, gradually increasing in length and decreasing in diameter to the tip. Thorax robust, flattened above. Epinotum rounded, sloping, without distinct basal and declivous surfaces, unarmed. Petiole and postpetiole similar to those of the worker. Gaster and legs slender.

Smooth and shining; head opaque, densely and finely punctate.

Hairs pale yellow, tapering, short, suberect and sparse on the body, appressed and inconspicuous on the appendages.

Pale, yellow; upper surface of head and gaster fuscous. Wings hyaline, with pale, sordid yellow veins and stigma.

Described from numerous specimens taken from several colonies nesting under stones at Austin and New Braunfels, Texas.

This species belongs to the *flavens* group and is closely related to *Ph. floridana* Emery. The soldier of *constipata* is, however, somewhat smaller, has the middle of the clypeus smooth and shining, without a median carina, and the thorax is punctate and opaque throughout, not shining above as in *floridana*. A typical worker of this latter species, received from Prof. Emery, has longer hairs and lacks the infuscation of the head, gaster, femora, etc. of *constipata*. It would, perhaps, be permissible to regard both of these forms and the next as representing subspecies of flavens.

88. **Pheidole lauta** sp. nov.

Soldier. Length: 2.25–2.5 mm.

Head, excluding the mandibles, a little longer than broad, about as broad in front as behind, with rounded posterior corners, broadly and angularly excised posterior border and rather deep occipital groove. Mentum with short, but distinct teeth. Eyes moderate, ⅓ the distance from the anterior to the posterior border of the head. Mandibles with two large apical teeth. Clypeus longitudinally depressed in the middle, with several longitudinal ridges and a median keel; anterior border with a broad, shallow excision in the middle. Antennal scapes reaching about ⅓ the distance between the eyes and posterior corners. Club as long as the remainder of the funiculus; joints 2–8 of the latter about as long as broad. Frontal carinæ continued back as ridges which are as long as the antennal scapes and mesially bound shallow and narrow antennal sulci. Frontal area impressed, subtriangular, carinulate. Thorax robust, through the prominent but rounded humeri about ½ as broad as the head. Pro- and mesonotum convex, together forming a hemispherical mass in profile, the mesonotum distinctly angulate with abrupt posterior surface. Mesoëpinotal constriction pronounced. Epinotum with base longer than the declivity in profile. Spines stout and acute, longer than broad at the base, as long as the basal surface, continued as ridges anteriorly and posteriorly. Surface of epinotum between the spines oblique and flattened. Petiole about twice as long as broad, slightly broader behind than in front, with concave sides and a high, anteroposteriorly compressed node, which has a rather thin, entire, transverse upper border. Postpetiole a little more than twice as broad as the petiole, a little broader than long, with distinct median conules on the sides. Gaster smaller than the head, elliptical, with straight anterior border. Legs rather long and stout.

Mandibles and clypeus shining, the former with coarse, widely scattered punctures, the latter longitudinally rugose. Head opaque, very finely and densely punctate, posterior ¼ smooth and shining, anterior half rather finely, longitudinally rugose except in the antennal sulci which are uniformly punctate. Thorax, petiole and postpetiole reticulate-punctate, subopaque, except for a small, smooth and shining area on the middle of the pronotum. Gaster and legs glabrous.

Hairs yellow, long, tapering, suberect and rather abundant on the body, shorter and more reclinate on the appendages.

Ferruginous, mandibular teeth black; gaster more or less infuscated behind; legs and antennæ yellowish.

Worker. Length: 1.5 mm.

Head, excluding the mandibles, a little longer than broad, with rather rounded sides and a slight emargination of the posterior border. Eyes distinctly in front of the middle. Mandibles with two large apical and several basal teeth. Clypeus flattened, with straight, entire anterior border. Antennal scapes reaching a little beyond the posterior corners of the head. Frontal carinæ short. Frontal area shallow, subtriangular, with a few longitudinal ridges. Thorax similar to that of the soldier but narrower in front and with much more sloping humeri. Petiole as in the soldier. Postpetiole twice as broad as the petiole, as long as broad, with the sides distinctly angulate in the middle. Gaster smaller than the head, elliptical, flattened, with straight anterior border. Legs well developed.

Whole head, including the clypeus, mandibles and frontal area, opaque, finely and densely punctate, cheeks with faint longitudinal rugæ. Thorax, petiole and postpetiole uniformly and densely punctate, opaque. Gaster smooth and shining, with the anterior third of the first segment opaque.

Hairs like those of the soldier, but sparser on the body, obtuse though not enlarged at their tips; on the appendages very delicate, pointed and appressed.

Ferruginous; gaster somewhat darker behind; legs more yellowish.

Female. Length. 4.5 mm.

Head, excluding the mandibles, nearly as broad as long, somewhat broader behind than in front, with nearly straight posterior border. Posterior orbits at the middle of the head. Mandibles like those of the soldier. Clypeus carinate in the middle, with a broad notch in its anterior border. Antennal scapes extending to a little behind the eyes. Thorax through the wing insertions as broad as the head, flattened above. Epinotal spines short and acute, as long as broad at the base. Petiole like that of the soldier, but relatively shorter. Postpetiole fully twice as broad as the petiole, less than twice as broad as long, with very blunt, long conules on the middle of the sides. Gaster suboblong, with concave anterior border. Legs rather slender.

Mandibles shining, sparsely and coarsely punctate. Clypeus, frontal area and head longitudinally rugose, subopaque, front and vertex also finely and densely punctate. Occipital region and posterior corners somewhat smooth and shining. There is no shining impression in front of the anterior ocellus. Thorax shining, pronotum opaque, finely and transversely punctate-rugulose. Mesonotum finely and longitudinally striate except on the middle in front. Scutellum with a few scattered foveolæ. Petiole and postpetiole shining, faintly reticulate-rugulose. Gaster shining, with small, scattered piligerous punctures.

Hairs yellow, rather long and abundant, tapering, suberect both on the body and appendages.

Ferruginous; borders of mandibles and clypeus black; gaster fuscous or black, with the anterior and posterior borders of the segments lighter. Legs yellow.

Male. Length: 3–3.5 mm.

Head, including the large eyes, as long as broad, without cheeks, protruding behind in the ocellar region. Mandibles small, barely overlapping with their acute, tridentate tips. Clypeus subcarinate, rounded in front. Antennæ rather short; scape very small, shorter than the two first funicular joints which are subequal in length, although the first joint is globose and nearly as broad as long. Remaining joints cylindrical, of uniform diameter but gradually lengthening distally. Thorax robust, mesonotum not much flattened above. Epinotum somewhat concave but without traces of spines. Petiole and postpetiole similar to those of the worker, but the node of the former is lower, rounded and not compressed anteroposteriorly. Legs long and slender.

Shining and sparsely punctate; head opaque and very finely punctate.

Hairs yellow, short, moderately abundant, suberect both on the body and appendages.

Uniformly pale yellow; only the ocellar triangle and eyes black. Wings hyaline with pale, sordid yellow veins and stigma.

Described from numerous specimens taken from several colonies nesting under stones at New Braunfels, Texas, about the sources of the Comal River.

This species is even more closely related to *Ph. floridana* than the preceding. The soldier, however, has the clypeus longitudinally rugose in the middle, the thorax almost entirely punctate and the mesonotum less angular. The worker has the base of the gaster opaque whereas this is shining in a type specimen of *floridana* given me by Prof. Emery. From *constipata*, the soldier of *lauta* is readily distinguished by the keeled and rugose clypeus, the long tapering hairs and the finer sculpturing of the head; the worker by the longer antennal scapes, opaque mandibles, clypeus, frontal area and base of first gastric segment; the female by the sculptured clypeus, absence of a smooth depression in front of the first ocellus, more extensively sculptured mesonotum and paler wing insertions; the male in having only the ocellar region instead of the whole upper surface of the head, black.

89. **Pheidole nuculiceps** sp. nov.

Soldier. Length: 2 mm.

Head, excluding the mandibles, as long as broad, very convex above, as broad in front as behind, with rather convex sides, rounded posterior angles and distinct but not very deep occipital excision and groove. Mentum with well-developed, pointed teeth. Mandibles convex, with two large apical teeth. Clypeus without a median carina, rather convex, with a shallow median notch in the anterior border. Antennal scapes reaching nearly half way between the eyes and the posterior corners of the head; joints 2–8 of the funiculus broader than long. Frontal carinæ prolonged backward as ridges nearly as long as the antennal scapes. Frontal area impressed, subtriangular, carinulate. Thorax short and robust, pro- and mesonotum very convex, with prominent humeral angles, the mesonotum angular, with a long, abrupt posterior surface which forms a right angle with the base of the epinotum. Epinotum with the declivity longer than the base. Spines slender and pointed, half as long as the base, a little further apart than long, continued into anterior and posterior ridges at the base and directed upward and slightly backward and outward. Space between the spines concave and sloping. Petiole more than twice as long as broad, distinctly broader in front than behind, with concave sides and a conical node, which is much rounded above and very slightly compressed anteroposteriorly. Postpetiole twice as broad as the petiole, less than twice as broad as long, broadest in front, where its sides are angularly produced. Gaster somewhat smaller than the head, broadly elliptical, flattened, with straight anterior margins. Legs rather long and slender.

Shining; mandibles with rather small, sparse punctures; clypeus smooth in the middle, rugose on the sides. Head throughout with sharp longitudinal rugæ and feebly punctate interrugal spaces. Thorax densely punctate-reticulate, the pro- and mesonotum more opaque, with fine transverse rugæ above. Petiole and postpetiole subopaque, finely and densely punctate, the latter smoother and shining above. Gaster shining, with scattered piligerous punctures.

Hairs yellow, suberect, long, pointed and rather abundant; on the legs and scapes more appressed or reclinate.

Ferruginous red; legs more yellowish; mandibular teeth black.

Worker. Length: 1.3 mm.

Head, excluding the mandibles, but little longer than wide, with rounded sides and slightly concave posterior border, with the eyes just in front of the middle. Mandibles wth two large apical and several small basal teeth. Clypeus convex, its anterior border without a distinct median notch. Antennal scapes extending a little beyond the posterior corners of the head. Thorax similar to that of the soldier but pro- and mesonotum much lower and narrower, and the posterior surface of the latter forming an obtuse angle with the base of the epinotum. Petiole like that of the soldier, but with lower and more conical node. Postpetiole about 1½ times as broad as the petiole, as long as broad, somewhat rectangular, with subparallel sides. Gaster nearly as large as the head.

Mandibles and clypeus shining; head and thorax opaque, densely and finely punctate; cheeks and sides of front also finely reticulate-rugose. Petiole and postpetiole densely punctate with the upper surfaces of the nodes smoother and more shining. Gaster smooth and shining.

Hairs like those of the soldier.

Ferruginous; mandibles, legs and gaster more yellowish.

Described from a single soldier and three workers taken at New Braunfels, Texas, at the sources of the Comal River.

This is very distinct from all the described North American species of the *flavens* group. It resembles *Ph. exigua* Mayr. of South America very closely, but the soldier of *nuculiceps* has the sculpture of the head heavier and covering even the occiput, which is smooth and shining in *exigua*, and the antennal sulcus is not so broad and deep. Two workers of *exigua* received from Prof. Emery are yellow and not ferruginous like those of *nuculiceps*. If *exigua* be regarded as a subspecies of *flavens*, *nuculiceps* should, perhaps, have the same rank.

90. **Pheidole metallescens splendidula** subsp. nov.

(Pl. XXVI, Figs. 20 and 21.)

Soldier. Length: 2.6–3.2 mm.

Head, excluding the mandibles, somewhat longer than broad, as broad in front as behind, with rounded sides, angularly excised posterior border and well-developed occipital groove. Eyes moderate, about ⅓ the distance from the anterior to the posterior corners. Teeth on the mentum small and indistinct. Mandibles with two large apical teeth. Clypeus flattened in the middle, without a median carina, and with a rounded notch in the anterior border. Antennal sulcus very shallow. Antennal scapes short, extending to about ¼ the distance between the eyes and the posterior corners of the head. Funicular joints 2–8 distinctly broader than long. Frontal carinæ not more than ¼ as long as the scapes. Frontal area deeply impressed, subelliptical, without a median carinula. Thorax robust, through the rounded humeri about half as broad as the head. Pro- and mesonotum rounded above, the latter angular behind, with oblique, somewhat concave posterior slope. Mesoëpinotal constriction broad and rather deep. Epinotum with subequal base and declivity, sloping between the spines, which are nearly half as long as the base, longer than broad at their insertions and with acute tips, directed backward and slightly upward and outward. Their bases are continued forward and backward as low slender ridges on the sides of the epinotum. Petiole somewhat less than twice as long as broad, broader behind than in front, with concave sides and a high, antero-posteriorly compressed node, which has a blunt, transverse superior border. Post-petiole about twice as broad as the petiole and somewhat less than twice as broad as long, with the sides produced in the middle as distinct angles. Gaster much smaller than the head, elliptical, flattened, with straight anterior border. Legs rather robust, with somewhat incrassated femora.

Mandibles and clypeus shining, the former with coarse, scattered punctures, the latter smooth in the middle with longitudinally rugose sides. Head nearly opaque, densely punctate and on the anterior two thirds longitudinally rugose, the posterior third also with shallow elongated foveolæ and the extreme occipital portion smooth and shining. Floor of the occipital groove not transversely crenate. Antennal sulci reticulate-rugose. Thorax, petiole, and postpetiole opaque, densely punctate or reticulate; upper surface of postpetiole smoother and shining, pro- and mesonotum loosely and reticulately rugose. Gaster glabrous.

Hairs pale yellow, erect, obtuse, shorter on the head, longer and more conspicuous on the trunk and especially on the gaster. On the legs and antennæ they are very short and tapering, suberect or reclinate.

Ferruginous, varying to dark brown; gaster black with more or less of the base of the first segment ferruginous, the black portion usually with metallic blue reflections which may also extend to the upper portion of the thorax. Middle portion of femora often darker than the remainder of the legs. Edges of mandibles and anterior border of clypeus black.

Worker. Length: 1.3–1.5 mm.

Head, excluding the mandibles, longer than broad, with nearly straight posterior margin and slightly convex sides. Eyes distinctly in front of the middle. Mandibles with two large apical and several small basal teeth. Clypeus convex behind, with very faintly excised anterior border. Antennal scapes reaching a little beyond the posterior corners of the head. Thorax resembling that of the soldier, but the pro- and mesonotum are much lower and narrower. Epinotal spines about ⅓ as long as the base of the epinotum, acute, longer than broad at their bases. Petiole twice as long as broad, scarcely broader behind than in front, with subparallel sides and high, anteroposteriorly compressed node similar to that of the soldier. Postpetiole less than twice as broad as the petiole, and less than twice as broad as long, with faintly angled sides. Gaster somewhat smaller than the head, elliptical, flattened, with straight anterior border.

Mandibles and clypeus shining, the former sparsely punctate, the latter very smooth in the middle. Head, thorax, petiole and postpetiole subopaque, densely punctate or reticulate, except for a longitudinal strip on the front and vertex, a spot on the middle of the mesonotum and the upper surface of the postpetiole, which are smooth and shining. Cheeks and sides of front longitudinally rugulose. Gaster and legs glabrous.

Pilosity similar to that of the soldier, but sparser. In some specimens the obtuse hairs are white instead of yellow.

Deep metallic violet, the upper surface of the head, excluding the cheeks, the pro- and mesonotum metallic green or blue. In some specimens, possibly immature, the thorax, petiole and postpetiole and base of gaster are red or yellowish with blue or green metallic reflections. Mandibles, antennæ and legs yellow, antennal clubs and middle portions of femora and tibiæ more or less infuscated or black; the femora often metallic violet.

Female. Length: 4–4.5 mm.

Head, excluding the mandibles, nearly square, but little broader behind than in front, sides rather straight, posterior margin feebly concave. Porterior orbits at the middle of the head. There is a very deep impression just in front of the anterior ocellus. Mandibles and clypeus like those of the soldier. Frontal area deep, triangular, with a median carinula. Antennal scapes reaching a little behind the posterior orbits. Thorax of the usual shape, about as broad as the head, much flattened above. Epinotal spines robust, acuminate, somewhat longer than broad at their bases, directed backward and slightly upward, about twice as far apart at their bases as long. Petiole 1½ times as long as broad, violin-shaped, broader behind than in front, with a high anteroposteriorly compressed node, with transverse summit, feebly notched in the middle. Postpetiole twice as broad as the petiole and somewhat more than twice as broad as long, with acute conules on the middle of the sides. Gaster suboblong, with straight anterior border.

Mandibles, clypeus and frontal area shining, the first coarsely and sparsely punctate, the second longitudinally rugulose even in the middle. Head, subopaque, anterior ⅔ longitudinally rugose, occipital region reticulate-rugose. Pronotum and epinotum opaque, the former finely and transversely punctate-rugulose, the latter densely punctate, remainder of thorax shining and sparsely punctate; mesonotum longitudinally striated behind. Petiole and postpetiole subopaque, very finely and densely punctate, nodes somewhat shining above. Gaster shining, with scattered piligerous punctures.

Hairs yellowish, rather short, pointed, suberect, not very abundant; suberect and nearly as long on the legs and scapes as on the body.

Ferruginous; anterior portion of head, antennæ, legs, mandibles, lower portions of thorax and pedicel more yellowish; gaster black, with its anterior corners red. Wings yellowish hyaline with dilute yellow veins and stigma.

Male. Length: 3.2 mm.

Head through the eyes about as broad as long, produced behind, without cheeks. Mandibles small, scarcely overlapping with their acute bidentate tips. Clypeus carinate, angularly rounded in front. Antennæ slender, scapes as long as the two basal joints of the funiculus taken together; first funicular joint globular, as broad as long, remaining joints cylindrical, gradually increasing in length and decreasing in thickness to the tip. Thorax robust, through the wing insertions much broader than the head, flattened above. Epinotum with convex base and slightly concave declivity, unarmed. Petiole twice as long as broad, slightly broader behind than in front, with low, rounded node. Postpetiole about 1½ times as broad as the petiole, broader than long, with faintly angular sides. Gaster and legs slender.

Shining; head opaque, very finely and densely punctate.

Hairs yellowish, very slender, acute, suberect, not very abundant; reclinate and inconspicuous on the legs and antennæ.

Pale yellow; head black above, clypeus and gaster dark brown. Wings like those of the female.

Texas: Austin, Montopolis, Del Valle, Marble Falls, and Del Rio (Wheeler); Denton (W. H. Long).

Described from numerous soldiers workers and females and two males taken from small crater nests in the soil. The colonies of this exquisite little ant comprise only a few dozen individuals. My specimens show considerable variation in coloration, especially in the workers, although these are always highly metallic. Emery described the species *metallescens* from workers only. I have found both the workers and soldiers of this form in small crater nests in the sandy grounds about Jacksonville, Florida. The head of the worker is much smoother above than in the subspecies *splendidula* and the soldiers have the rugæ of the head coarser and more reticulate behind. In this caste, too, there are no metallic reflections on the gaster, which is dark brown or blackish. The specimens from Del Rio resemble the typical Florida form more closely in the sculpturing of the head of the worker, but the gaster of the soldier is metallic blue as in the other Texas specimens. The discovery of the soldiers of *metallescens* shows that Emery was right in supposing that this *Pheidole* belongs to the *flavens* group.

91. **Pheidole lamia** *Wheeler.*

(Pl. XXVI, Figs. 14–17.)

WHEELER, Am. Natur., XXXV, 1901, pp. 534, 535, fig. 11, ♃ ☿.

Soldier. Length: 2.5–2.7 mm.

Head, excluding the mandibles, about twice as long as broad, somewhat wider in front than behind, with straight sides. Posterior border angularly excised, with a very short and broad occipital groove. In profile the head is somewhat deeper in front than behind, with flattened dorsal and ventral surfaces. The front and clypeus are peculiarly truncated, the former presents three large concave areas separated and bordered by prominent ridges, the latter is flat with nearly straight anterior border. The mandibles too, are flattened in the same plane as the clypeus and front, and somewhat triquetral in shape, so that the anterior portion of the head resembles that of the Camponotine subgenus *Colobopsis.* The inner border of each mandible is furnished with two small apical and two very similar basal teeth. Frontal area lacking. The frontal carinæ are straight, nearly parallel, slightly diverging behind, extending back almost half way to the posterior corners of the head and forming the mesial borders of shallow grooves for the antennal scapes. Eyes small, with about 6–8 ommatidia in the longitudinal diameter, situated somewhat less than a fourth the distance from the anterior to the posterior corners of the head. Antennæ short, scape as long as the frontal carinæ, angularly bent at the base. Funiculus exceeding the length of the scape by the length of the club; the latter distinctly shorter than the remainder of the funiculus. First funicular joint as long as the four succeeding joints; joints 2–8 uniform, broader than long. Thorax somewhat shorter than the head, excluding the mandibles; promesonotum ⅔ as broad as the head, convex and hemispherical above, without humeral angles and with a faint swelling on the posterior slope, which is often abrupt and forms nearly a right angle with the base of the epinotum. Mesoëpinotal constriction pronounced. Epinotum short, its basal surface horizontal, a little longer than the steep and concave declivity; spines short and tooth-like, as broad at the base as long, erect and much farther apart than long. Petiole somewhat less than twice as long as broad, violin-shaped, narrower in front than behind; in profile toothless below, with an abrupt, antero-posteriorly compressed node, the upper border of which, seen from behind, is slightly notched in the middle. Postpetiole twice as broad as the petiole through the node, broader than long, with acute, median lateral conules which are convex anteriorly, and concave posteriorly; in profile very convex above, flattened beneath, with a distinct anteromedian denticle. Gaster elongate elliptical, with parallel sides, as large as the head. Legs rather robust, with incrassated femora and clavate tibiæ.

Mandibles, clypeus and front opaque, irregularly rugose. Remainder of body smooth and shining; cheeks and space between frontal carinæ with sharp longitudinal rugæ, diverging in the latter region from the median line.

Hairs rather short, erect, pale yellow, covering the body and legs.

Truncated anterior portion of head and mandibles brown, remainder of body yellow; legs slightly paler.

Worker. Length: 1.5–1.8 mm.

Resembling the workers of other species of *Pheidole.* Head, excluding mandibles, barely longer than broad, a little broader behind than in front, with rounded posterior corners and slightly convex sides. Mandibles with two large apical and four smaller basal teeth. Eyes as large as those of the soldier, about ⅓ the distance from the anterior to the posterior corners of the head. Clypeus convex, with its anterior border faintly and sinuately excised in the middle. Frontal area small, triangular. Antennæ similar to those of the soldier but the scape is not angulate at the base and reaches to the posterior corner of the head. Frontal carinæ very short. Thorax similar to that of the soldier but the promesonotum is less convex and the spines on the epinotum are reduced to minute teeth. Petiole small and narrow, with thicker and more rounded node than in the soldier. Postpetiole a little broader than the petiole, as long as broad, rounded and convex above and on the sides. Gaster elliptical, but little longer than broad.

Smooth and shining throughout.

Pilosity like that of the soldier.

Yellow, with the mandibular teeth and anterior border of clypeus brown.

Texas: Austin.

The soldier of this singular species, of which I have found several colonies under stones, is unlike any other known *Pheidole* in the peculiar structure of the head, and deserves, perhaps, to be placed in a subgenus by itself. This singular structure is so much like that of *Colobopsis* that we are justified in believing that the soldiers use their heads for plugging up the entrances to the nest galleries. The species is truly hypogæic. The large size of the gaster and the small number of soldiers (1–4) found in a colony, suggest that this caste may, perhaps, function as the queen of the species.

92. **Cremastogaster lineolata opaca** *Mayr.* var. **depilis** var. nov.

The study of *Cremastogaster lineolata* specimens from a large number of colonies in the southwest proves to be unusually difficult because the forms show transitions to the Mexican *C. opaca,* which Emery justly regards as merely a subspecies of *lineolata,* to the Californian subspecies *coarctata,* and through the subspecies *læviuscula* to the more typical *lineolata* of the Northern and Eastern States.

In Mexico the var. *dentinodis* Forel, described from specimens which I took at Queretaro, is connected with the typical subsp. *opaca* by a number of intermediate forms collected by J. F. McClendon at Guadalajara, Juanacatlan, and Tuxpan. Some of these are very dark and opaque and, like the typical *opaca,* lack the deticles on the posterior corners of the petiole, which is moreover distinctly broader than long. The epinotal spines are long, very slender and pointed and distinctly diverging. The head is very opaque and finely reticulate-rugose or densely punctate, except for a narrow, shining, frontal streak. The mandibles, clypeus and cheeks are densely and longitudinally striated. This form is connected with the eastern *lineolata* through the variety *subopaca* Emery, a variety which may be more appropriately attached to *opaca* than to the typical *lineolata.* It has the diverging, attenuate spines of the northern form, but the head and gaster are less densely punctate and therefore more shining.

A number of specimens taken at Del Rio, Texas (Wheeler), Alamogordo, New Mexico (Viereck), Cerro Carrigal and Cerro Chilicote, Chihuahua, Mexico (C. H. T. Townsend) may be regarded as a distinct variety (*depilis* var. nov.) intermediate between the typical *opaca* and the form which Emery has described as an independent species under the name of *punctulata.* The typical form of *depilis* from Cerro Carrigal has the thorax, petiole and postpetiole uniformly opaque and densely punctate, the pronotum also finely rugulose. The head is distinctly shining in front but more opaque and densely punctate towards the occiput. The gaster is shining and finely punctate at the base. There are almost no erect hairs on the upper surface of the head, thorax and gaster, but those on the head and gaster are short and closely appressed, those on the legs still shorter and less conspicuous. The head, thorax, pedicel and legs are ferruginous red, the top of the head and the first gastric segment chestnut brown. The epinotal spines are somewhat shorter, less attenuate and more parallel than in the typical *opaca.* There are no denticles at the posterior corners of the petiole. The antennal scapes barely extend beyond the posterior corners of the head. A note accompanying the specimens of *depilis* sent me by Mr. Townsend, says that "they were nesting in the branches of mesquite tenanted by longicorn beetle larvæ, in a tunnel 2 to 3 ft. long. The ants were in constant attendance on Coccids (*Pulvinaria* sp.?) on the outside of the branches and also in the cavities of the nest."

93. **Cremastogaster lineolata opaca** *Mayr.* var. **punctulata** *Emery.*

Cremastogaster punctulata Emery, Zool. Jahrb., Abth. f. Syst., VIII, 1894, p. 287, ☿.

Texas: Austin, Henrietta, Fort Stockton, Fort Davis, Alice, San Angelo (Wheeler); Paris, (Miss Augusta Rucker); Amarillo (T. D. A. Cockerell).

New Mexico: Las Vegas (T. D. A. Cockerell).
Colorado: Cañon City (P. J. Schmitt).
Kansas: Douglas County (Miss Clara Klaumann).
Mexico: Ojos del Diablo, Chihuahua (C. H. T. Townsend).

This form, which, I believe, should be reduced to varietal rank, is very similar to *depilis* in sculpture and coloration. The punctation of the head and thorax, however, are less dense, so that these parts are more shining, and the petiole is always shining in certain lights, not uniformly opaque as in *depilis* and the typical *opaca*. The epinotal spines are parallel and acute and the body is covered with sparse, suberect, obtuse hairs, in addition to the short appressed hairs of *depilis*.

Several deälated females taken at Austin and Alice by myself and by Townsend at Ojos del Diablo, and several winged specimens taken by Cockerell, May 10, at Las Vegas during their marriage flight, measure 6.5–7 mm. They have the whole head opaque, densely and longitudinally striated and punctate like the typical *opaca*, but the thoracic dorsum and gaster are smooth and shining, the mesonotum and scutellum with sparse, coarse punctures. The epinotal spines are short, not longer than broad at the base, rather blunt and directed backward. The head and thorax are black like the gaster, the mandibles, appendages and thoracic sutures deep red.

This variety nests in the ground under stones though it attends aphids on low herbaceous plants. A note accompanying the specimens from Ojos del Diablo describes them as nesting under a stone in grass "encrusted with the saline deposit from hot springs."

94. **Cremastogaster lineolata** *Say*, subsp. **læviuscula** *Mayr*.

Cremastogaster læviuscula Mayr, Verh. zool. bot. Ges. Wien, XX, 1870, pp. 990, 993, ☿; Dalla Torre, Catalog. Hymen., VII, 1893, p. 83 ☿.

Cremastogaster lineolata subsp. *læviuscula* Emery, Zool. Jahrb., Abth. f. Syst., VIII, 1894, pp. 284, 285, ☿.

The types of this subspecies were from Fort Cobb, Texas. I have taken specimens at Austin, Del Valle, Montopolis and Galveston, Texas and have received several from Plano, Texas (E. S. Tucker) and Gallinas Cañon, New Mexico (T. D. A. Cockerell). As the name indicates, this ant is characterized by its smoothness; the head, thorax and pedicel of the worker being shining and very finely punctate above. The epinotal spines are rather long, acute and diverging. The female is readily distinguished from the typical *lineolata* by the color. The head, thorax, pedicel, basal portion of the first gastric segment and the legs and antennæ are red, with large brown anteromedian and parapsidal blotches on the mesonotum, and black scutellum and mesonotum. The head is coarsely and densely, the upper surface of the thorax more finely punctate. The wings in both sexes are hyaline. Length 8.5–9 mm.

This subspecies is not at all uncommon, nesting in the galls made by *Holcaspis cinerosus* on live-oaks (*Quercus virginiana*) in central Texas. I have often taken females, workers and males together in a single gall. As these colonies are always small and as the colonies of the variety *clara* nesting in the galls on the same trees are always more populous I am inclined to believe that *læviuscula* is merely the incipient nest form of *clara*. This is also indicated by the fact that the males and females of both forms are indistinguishable and the workers of *læviuscula* are always much smaller than those of *clara*.

95. **Cremastogaster lineolata læviuscula** var. **clara** *Mayr*.

Œcodoma (*Atta*) *bicolor* Buckley, Proc. Ent. Soc. Phila., VI, 1867, p. 350, No. 67, ☿.
Cremastogaster clara Mayr, Verh. zool. bot. Ges. Wien, XX, 1870, pp. 990, 993, ☿; McCook, in Comstock's Rep. on Cotton Insects, 1879, p. 188, No. 5, ☿.
Cremastogaster leviuscula var. *clara* Dalla Torre, Catalog. Hymen., VII, 1893, p. 83, ☿.
Cremastogaster lineolata subsp. *læviuscula* var. *clara* Emery, Zool. Jahrb., Abtb. f. Syst., VIII, 1894, p. 285, ☿.

Texas: Fort Cobb (Mayr); Austin, Del Rio, Alice, Hays County, Langtry, New Braunfels (Wheeler); Laredo (J. F. McClendon); Paris (Miss Augusta Rucker).

Arizona: (Emery).

Mexico: Rio Santa Maria, Chihuahua (C. H. T. Townsend).

Indiana: (Emery).

The workers and females are readily distinguished from those of all the other North American forms of *C. lineolata* by the bright yellowish red color of the head, thorax, pedicel, appendages and extreme base of the gaster, contrasting strongly with the black of the remainder of the gaster. Wings of male and female white, with pale yellow veins. Length of worker 3.5–4.5 mm., female 8–9 mm., male 4–4.5 mm.

This species, as I have said, is probably the mature colonial form of *C. læviuscula*. It nests in large colonies in old logs and occasionally under stones. In its habits and nauseating odor it closely resembles the northern *lineolata*.

96. **Cremastogaster lineolata coarctata** *Mayr.*

Emery, Zool. Jahrb., Abth. f. Syst., VIII, 1894, pp. 283, 284.

A number of workers taken in attendance on large coccids on mesquite (*Prosopis velutina*) at Tucson, Arizona, agree very well with Emery's description of this variety, which has the head subopaque behind and densely punctate, the thorax and pedicel opaque and confluently punctate. The epinotal spines are long, acute and diverging. The color is much duller than that of the variety *clara* and the entire gaster is black. The antennal scapes surpass the posterior corners of the head by a distance equal to their greatest diameter. Length 3.8–4.5 mm.

97. **Cremastogaster lineolata coarctata** var. **mormonum** *Emery.*

Emery, Zool. Jahrb., Abth. f. Syst., VIII, 1894, p. 284, ☿.

Texas: Fort Davis, in woody galls on *Quercus cinerea* (Wheeler).

New Mexico: Romeroville (T. D. A. Cockerell).

Utah: Salt Lake and East Mill Creek (C. V. Chamberlin).

The Fort Davis specimens measure 3–3.5 mm., those from Romeroville slightly less. Some of the larger workers from Utah measure 3.5–5 mm. In these the scapes surpass the posterior corners of the head by fully twice their greatest diameter. The sexual forms are also unusually large, the females measuring 10–11 mm.; the males 3.8–4 mm. Both are colored like the corresponding forms of *lineolata*. The wings are faintly smoky, with brown veins and stigma.

98. **Cremastogaster ashmeadi** *Mayr.*

Cremastogaster ashmeadi Mayr, Verh. zool. bot. Ges. Wien, XXXVI, 1886, p. 463, ☿ ♂; Dalla Torre, Catalog. Hymen., VII, 1893, p. 79; Emery, Zool. Jahrb., Abth. f. Syst., VIII, 1894, p. 286, ☿.

Texas: Denton (W. H. Long); Paris (Miss Augusta Rucker).

The workers from these localities in northern Texas agree very closely with typical specimens of the Florida form received from Professor Emery and Mr. Pergande.

99. **Cremastogaster arizonensis** sp. nov.

(Pl. XXVII, Fig. 40.)

?*Cremastogaster brevispinosa* var. Fenner, Ent. News., VI, 1895, p. 216.

Worker. Length: 2–3 mm.

Head as broad as long, with slightly concave occipital border. Mandibles narrow. Antennæ 11-jointed, with the scape not reaching the posterior corner of the head by fully its greatest breadth. Club 2-jointed, joints 2–7 of funiculus broader than long, 8th joint as broad as long. Promesonotum as broad as long, with prominent but rounded shoulders, not marginate on the sides. Mesoëpinotal constriction pronounced. Epinotum broader than long, sloping and flattened between the spines so that there is no distinct basal surface. Near the anterior end there is a small median projection. Spines short, not longer than broad at their bases, much further apart than long and directed upward and in some cases with their tips slightly turned forward. Petiole elliptical, longer than broad, with anterior and posterior ends truncated, distinctly denticulate behind, with a small anteroventral tooth. In profile the height of the segment behind is less than half its length. Postpetiole distinctly broader than long, convex above, transversely elliptical, without any trace of a median longitudinal furrow. Gaster with a very acute, slightly prolonged and upturned tip.

Shining; mandibles opaque, rather coarsely striato-punctate, clypeus and cheeks finely striated longitudinally. Head with very sparse and small punctures. Thorax subopaque, promesonotum and sides and base of epinotum finely striato-punctate, epinotal slope smooth and shining as are also the gaster, petiole and postpetiole.

Hairs and pubescence white and sparse, the former erect, the latter rather uniformly covering the body.

Dark chestnut brown, almost black. Antennæ and legs somewhat paler. Mandibles and gula yellowish.

Numerous specimens found running on cottonwood trees at Tucson and Phoenix, Arizona. This is probably the species cited by Fenner as *C. brevispinosa* var. which he found nesting in "large colonies; one nest observed under root of cotton-wood tree; immense number of ants traveling in columns in many directions, but sluggish and slow in movements."

This species is closely related to *C. brevispinosa* Mayr, *virgula* Forel and *rochai* Forel. From *brevispinosa*, it differs in the shorter antennal scapes, very different sculpture, shorter and less convex base of the epinotum, and in having no traces of a longitudinal impression on the postpetiole, etc. From *virgula* it differs in the much broader postpetiole, which is not constricted in front, the presence of denticles on the petiole, the absence of the marginate sides to the pro-mesonotum, etc. From *rochai* it may be distinguished by its much less pronounced sculpture, smaller anteromedian tooth on the petiole, and much smaller epinotal spines.

100. **Cremastogaster victima missouriensis** *Pergande.*

EMERY, Zool., Abth., f. Syst., VIII, 1894, pp. 287, 288, ☿.

Several workers collected by Miss Augusta Rucker at Paris, Texas, and five workers taken by Miss Clara Klaumann in Dickinson County, Kansas, agree very well with cotypes of this subspecies from Missouri, received from Mr. Pergande.

101. **Cremastogaster minutissima** *Mayr.*

Cremastogaster minutissima Mayr, Verh. zool. bot. Ges. Wien, XX, 1870, pp. 99, 995, ☿ ♀; Dalla Torre, Catalog. Hymen., VII, 1893, p. 83, ☿ ♀; Emery, Zool. Jahrb., Abth. f. Syst., VIII, 1894, p. 287.

A number of workers, females and males taken at Austin and New Braunfels, Texas, under stones in shady woods, appear to belong to this small yellow species, which might be more properly regarded as a subspecies of *victima*. The types, which are in the Stockholm Museum, are from Texas. According to Mayr, *minutissima* differs from *victima* in having smaller epinotal spines and a smoother surface, the female having rather prominent erect hairs on the legs. But *victima missourensis* has a smoother surface and the same pilosity in the female, and the males resemble those of *victima* very closely. I am unable to decide this question without more material. Neither of the forms seems to be at all common in Texas.

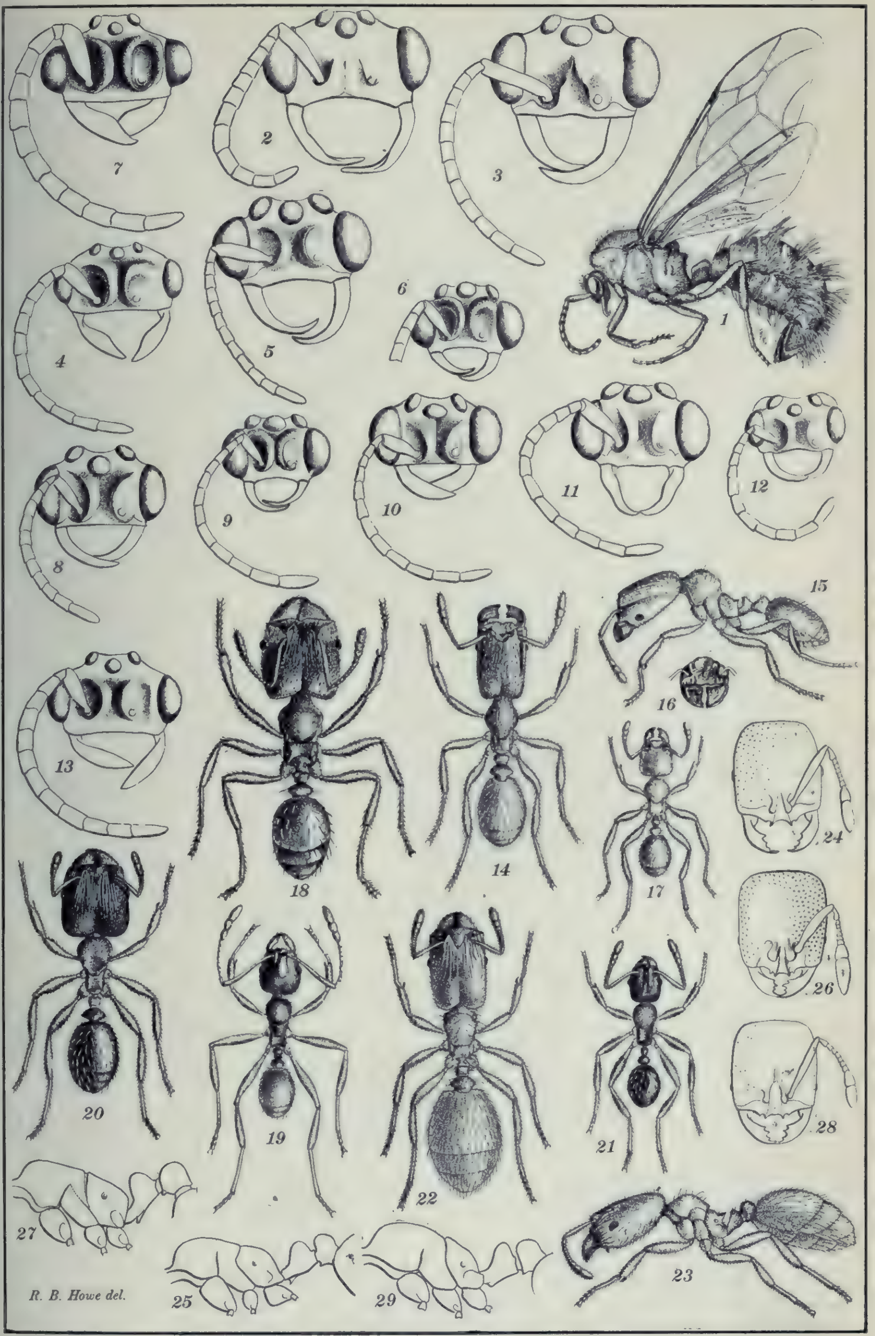
DESCRIPTION OF PLATES.

Plate XXVI.

Fig. 1. *Eciton esenbecki* Westwood, ♂.
2. Head of same.
3. *Eciton cæcum* Latreille, ♂. Head.
4. *Eciton* (*Acamatus*) *opacithorax* Emery, ♂. Head.
5. *Eciton* (*Acamatus*) *arizonense* sp. nov., ♂. Head.
6. *Eciton* (*Acamatus*) *minus* Cresson, ♂. Head.
7. *Eciton* (*Acamatus*) *nigrescens* Cresson, ♂. Head.
8. *Eciton* (*Acamatus*) *oslari* sp. nov., ♂. Head.
9. *Eciton* (*Acamatus*) *melshæmeri* Haldem., ♂. Head.
10. *Eciton* (*Acamatus*) *harrisi* Haldem., ♂. Head.
11. *Eciton* (*Acamatus*) *mexicanum* F. Smith, ♂. Head.
12. *Eciton* (*Acamatus*) *spoliator* Forel, ♂. Head.
13. *Eciton* (*Acamatus*) *schmitti* Emery, ♂. Head.
14. *Pheidole lamia* Wheeler, ♃.
15. Same in profile.
16. Head of same from the front.
17. *Pheidole lamia* Wheeler, ☿.
18. *Pheidole sciophila* sp. nov., ♃.
19. *Pheidole sciophila* sp. nov., ☿.
20. *Pheidole metallescens splendidula* subsp. nov., ♃.
21. *Pheidole metallescens splendidula* subsp. nov., ☿.
22. *Pheidole casta* sp. nov., ♃.
23. Same in profile.
24. *Solenopsis salina* sp. nov., ☿. Head.
25. Thorax and pedicel of same in profile.
26. *Solenopsis pilosula* sp. nov., ☿. Head.
27. Thorax and pedicel of same in profile.
28. *Solenopsis krockowi* sp. nov., ☿. Head.
29. Thorax and pedicel of same in profile.

Plate XXVII.

Fig. 30. *Pheidole titanis* Wheeler, ♃.
31. *Pheidole morrisi* Forel var. *impexa* var. nov., ♃.
32. *Pheidole hyatti* Emery, ♃.
33. *Pheidole texana* Wheeler, ♃.
34. *Pheidole texana* Wheeler, ☿.
35. *Pheidole crassicornis porcula* subsp. nov., ♃.
36. *Pheidole macclendoni* sp. nov., ♃.
37. *Pheidole xerophila* sp. nov., ♃.
38. *Pheidole pinealis* sp. nov., ♃.
39. *Pheidole humeralis* sp. nov., ♃.
40. *Cremastogaster arizonensis* sp. nov., ☿.


7
2
3
1
4
5
6
8
9
10
11
12
15
16
13
18
14
17
24
26
20
19
22
21
28
27
23
25
29
R. B. Howe del.

ANTS OF TEXAS, NEW MEXICO AND ARIZONA.

59.9, 735 R

Article XXII.— THE PEARY CARIBOU (*RANGIFER PEARYI* ALLEN).

By J. A. Allen.

A large series of specimens, including perfect skins and skulls of both sexes, and also of young adults, obtained by Commander R. E. Peary in northern Grant Land, in October, 1905, enable me to complete the description of this very distinct and beautiful species, which was originally described from imperfect skins, without skulls, taken by Commander Peary in Ellesmere Land, in June, 1902.[1] Its nearly pure white color and small size distinguish it strikingly from all other known species of the genus.

The present large series, numbering 67 skins and 53 skulls, was collected on Fielden Peninsula and in the vicinity of Lake Hazen, in about latitude 82° N., and hence about three degrees north of the type locality, which is near the northern border of Ellesmere Land. As, however, Ellesmere Land, Grinnell Land, and Grant Land form a continuous land area, with everywhere quite similar climatic conditions, the Caribou of Ellesmere Land and Grant Land are probably not markedly differentiated, although the gray brown mantle in the Ellesmere Land specimens is, with one exception, considerably darker than in the Grant Land specimens. This is hardly to be accounted for by difference of season, since the Ellesmere specimens, though taken in June, were still in winter pelage.

Rangifer pearyi differs from both *R. grœnlandicus* and *R. arcticus*, its nearest allies geographically, in being very much smaller, taking the skull as a basis for comparison (external measurements taken in the flesh are lacking), the *females* of *grœnlandicus* and *arcticus* being as large as the *males* of *pearyi*. In color *pearyi* is radically different, being sometimes almost as pure white as the Arctic Fox or the Arctic Hare, at least in effect when seen in life at a little distance. Peary's reference to this species in his 'Nearest the Pole' (1907, p. 57), "as this magnificent snow white animal," is hardly an exaggeration, although the median area of the back in nearly all the specimens shows a mixture of gray, varying in different individuals from a slight tinge of gray to gray-brown, and also in the extent of this area, which is sometimes much restricted, and sometimes forms a broad mantle.

The large series of skins of *R. grœnlandicus* here used for comparison was collected in November, by Commander Peary, at Inglefield Gulf, on the Greenland side of Baffin Bay, opposite Ellesmere Land. These skins greatly resemble in coloration the ordinary Woodland Caribou, being dark brown with the neck much lighter and the ventral area white. They thus give no suggestion of the whiteness of pelage shown by their relatives on the opposite side of Baffin Bay.

---

[1] This Bulletin, Vol XVI, pp. 419–412, figs 1 and 2, Oct. 31, 1902. Republished in Peary's 'Nearest the Pole,' 1907, pp. 350–352.

The series of *R. arcticus* (*Cervus tarandus*, var. *a. arctica* Richardson) is from near Wager River, north of Hudson Bay, and was collected in October by Captain George Comer. This locality is only a short distance from Melville Peninsula, which Richardson especially mentions as within the range of his variety *arctica*, although not strictly its type locality. This is a much lighter colored animal than *R. grœnlandicus*, from which it also differs in the character of the antlers. There is a blackish band across the chin, and a broad dark brown band across the nose, extending posteriorly in a V-shaped patch to nearly opposite the eyes; the cheeks, forehead and top of the head are lighter or yellowish brown; the throat, sides of the head up to the base of the ears, and the whole neck all around back to the shoulders, the whole ventral surface, inside of thighs, the buttocks, and the greater part of the tail are uniform cream-white. The limbs are dark brown nearly to the hoofs, adjoining which is a band of yellowish white, which extends upward for a short distance as a narrow median line on the posterior face of the carpal and tarsal segments. The whole body, except the ventral surface, is dark brown, passing into a lighter color on the flanks, where the hairs are tipped more or less with yellowish or pale fulvous, below which is a broad lateral band of dark brown.

In average specimens of *R. pearyi* the whole head and the limbs are uniform white,[1] like the neck and underparts, with a more or less strong grayish cast over the mid-dorsal area. From this they vary on the one hand to nearly pure white all over, and on the other to white with a grayish brown mantle, varying in different individuals, independently of sex and age, from drab-gray to drab-brown. In these darker specimens the dark chin and nose bands seen in other species of caribou are outlined by a faint plumbeous hue, the ears are similarly shaded, as is the median front surface of the fore legs, while the anterior face of the hind legs is distinctly pale drab-gray divided medially by a narrow white line, making the dark band double. Where these darker shades appear the pelage is brown basally, and the drab tint in places reaches the surface. Elsewhere the pelage is white to the base. Another striking feature of the pelage in *R. pearyi* is its extreme softness and fineness, in comparison with that of any other known caribou. In the Ellesmere Land specimens the pelage is less soft, but in these the coat is thinner and more worn, as they were killed just before the season of moult, which takes place in July.

---

[1] The whiteness of the head is well shown in the half-tone plate facing p. 80 of Peary's 'Nearest the Pole,' where two sledge loads of Caribou give a front view of two fine heads. The plate facing p. 346 gives also side and front views of a fine head.

As shown by the subjoined table, 15 of the largest and oldest male skulls of *R. pearyi* (all adult, with well-worn teeth) have an average total (condylobasal) length of 303 mm., ranging from 257 to 335 mm., the smallest being one of the oldest of the series, with the teeth most worn. The same length in a series of 7 old male *R. arcticus* is 363 (345–397) mm., and for 3 old female skulls of *arcticus* 320 (303–337) mm., or considerably more than the males of *pearyi*. Three male skulls of *grœnlandicus* average 368 (361–375) mm., or slightly more than the 7 skulls of *arcticus*, with slenderer, less palmated, and more recurved antlers.

In *R. pearyi* the main beam of the right antler in old males has an average length of 1019 mm., the longest measuring 1205 and the shortest 826, with 4 above 1100 mm. and 3 below 900 mm. In 7 *R. arcticus* the same average measurement is 1200 mm. (1062–1505), and in *R. grœlandicus* 1141 (1063–1246) mm. Thus the average in *arcticus* and *grœlandicus* about equals the maximum in *pearyi*.

In *R. pearyi* the antlers have a much greater upward curvature than in *arcticus*, in proportion to their length; those of the latter being remarkable for their long, low, backward sweep and slight divergence, although occasionally a specimen departs from this normal and approaches the curvature and divergence seen in *grœnlandicus* and *pearyi*. Figures 1–6 illustrate the types of antler seen in *pearyi*, and Figs. 7–10 the variation seen in two fine heads of *arcticus*, one of which presents the unusual feature of two large and equally developed brow antlers, one on each antler, directed one above the other, thus avoiding contact. An average adult skull of the female of *R. pearyi* is shown in Figs. 11 and 12.

The inward curvature of the distal third of the main beam in *R. pearyi* is especially marked, the distance between the tips being, in one third of the specimens, less than 150 mm., and in one specimen (Figs. 11, 12) they actually cross to the extent of 60 mm. The greatest spread (at point of palmation of main antlers) equals about one half to two thirds the length of the main beam. In 7 specimens the brow antler is developed from the right antler, in 8 others from the left. The brow antler increases in size with the age of the animal, being longest and broadest in very old animals and not well-developed in males that have just fully acquired the permanent dentition. In general the antlers are broader in all of their palmated parts, in proportion to their size, than in either *arcticus* or *grœnlandicus*.

A feature of interest in these skulls is the large amount of individual variation. One male skull, and also one female skull, has two well-developed canines on the same side, both of normal size, the supernumerary one standing in front of the other in a small piece of intercalated bone. There is the usual wide range of individual variation in the form and relative development of the various elements of the skull seen in other species of deer when large series of skulls are brought together for comparison. This is especially noticeable in the size and form of the nasal bones and lachrymal fossæ, and in the relation of the ascending branch of the premaxillaries to the maxillaries, etc., the same wide range of individual variation prevailing in this species as in *Odocoileus sinaloæ,* illustrated in a former paper.[1] A rather unusual feature is a false suture, outlining what at first sight seems to be an intercalated bone to fill the space between the ascending branch of the premaxillary and the maxillary, but the suture is superficial, appearing on the outer surface and usually not extending very deeply into the bone.

According to the experience of most travellers on the Arctic mainland, the so-called Barren Ground Caribou is a migratory animal, leaving the coast at the approach of winter and moving southward in great herds, to return northward again in the spring. This, however, does not appear to be the habit of the Grant Land Caribou, according to Commander Peary's notes on them in his 'Nearest the Pole' (New York, Doubleday, Page & Co., 1907). Thus, in referring to one of his hunting parties, he says: "After dinner [September 11, 1905], three Eskimos came in with the meat of four musk-oxen killed in Rowan Bay, and in the evening the Porter Bay party returned with the meat and skins of seven reindeer killed in a valley on Fielden Peninsula. These, the first specimens of this magnificent snow-white animal, were from a herd of eleven surprised in a valley close to Cape Joseph Henry, and among the seven was the wide-antlered buck leader. These beautiful animals, in their winter dress almost as white as the snow which they traverse, were found later scattered over the entire region from Cape Hecla to Lake Hazen, and westward along the north Grant Land coast, over fifty specimens in all being secured" (*l. c.,* p. 57). Later in the season "hunting parties of the Eskimos were kept constantly in the field, covering the country north to Clements Markham Inlet and south to Wrangel Bay and Lake Hazen. The results of these parties were satisfactory, considerable numbers of musk-oxen and reindeer being secured" (*l. c.,* p. 60). By October 1, the "game score reached seventy-three musk-oxen and twenty-seven reindeer." Other bags, comprising reindeer as well as musk-oxen, are reported as received October 25 and November 8. Under date of December 16 it is stated (*l. c.,* p. 84): "Two large buck reindeer were found on the southern slopes of the United States Range with their horns locked, frozen in a death struggle."

---

[1] This Bulletin, XXII, 1906, pp. 203–207, pll. xx–xxvi.

During Commander Peary's survey of the northern coast line of Grant Land, he states that late in June, 1906, on reaching Cape Hubbard, the northern point of Jesup Land (Heiberg Land of Sverdrup), he came immediately upon the recent tracks of six deer, and in just thirty-five minutes from the time he landed, his party had captured two deer and a hare. He says of these: "Both were does, neither pregnant, nor very large, and very thin though evidently putting on flesh, the skin of course in bad condition and antlers in the velvet. A very noticeable feature was the length of the hoofs, and the development of the dew claws into regular spoons as large as a hare's ears, thus giving the deer natural snowshoes, which they need in this country not only for the snow, but for the boggy saturated ground as well, at this time of year" (*l. c.*, p. 205). On June 29, at the same place: "At 2 P. M. the men returned. They found at close quarters that the three deer seen from the summit of the cape [Cape Hubbard] had increased to six and a fawn, all of which were secured (three bucks and three does)" (*l. c.*, p. 208). Two days later, on the Garfield coast, at the northwest corner of Grant Land, Commander Peary saw a deer grazing and sent the boys to bring it in, "which they did in about an hour (a buck with small horns in the velvet). This made twelve obtained thus far. A fresh track was seen between the tent and the sledge which we left; and another deer was seen on the opposite side of the bay" (*l. c.*, p. 210).

These references show that reindeer, or caribou, were present about July 1 on both sides of Fridtjof Nansen Sound, which was still so well closed with ice that Peary and his party crossed on the ice from Grant Land to Jesup Land and returned in safety at this late period in the season; which shows that during most of the year Nansen Sound must be here passable for caribou, and that the herds of Jesup Land (or Axel Heiberg Land) and Grant Land are practically the same herd. They also show that his hunting parties found both males and females commonly associated in the same herd, both in autumn (September-November) and in June and July; and that in winter as well as in summer caribou were met with practically to the northern border of the most northern of arctic lands.

Measurements of 21 Skulls of Rangifer pearyi.

	27930	27927	27937	27948	27920	27902	27901	27958	27988	27939	27925	27921	27987	27989	27913	27909	27914	27928	27954	27993	27909
	♂	♂	♂	♂	♂	♂	♂	♂	♂	♂	♂	♂	♂	♂	♂	♀	♀	♀	♀	♀	♀
Total length (condylobasal)	235	318	318	303	257	298	323	330	335	334	320	325	315	327	320	276	283	284	273	293	280
Tip of premaxillæ to tip of nasals	92	95	90	81	86	85	93	90	92	98	90	90	90	96	89	77	76	82	74	76	78
Tip of premaxillæ to alveolus of p^1	110	103	104	101	100	101	106	112	112	114	109	108	101	110	106	89	90	89	86	93	87
Length of nasals	102	94	103	107	90	100	97	104	109	102	105	105	82	94	107	82	96	76	85	95	76
Breadth of skull above m^2	105	102	96	99	105	103	104	104	113	111	106	103	103	103	103	93	97	96	89	96	91
Zygomatic breadth	135	130	131	127	127	126	129	130	132	129	132	131	129	127	127	119	114	113	111	121	114
Greatest breadth at orbits	159	157	155	153	153	155	153	161	163	160	151	161	164	156	157	140	142	134	129	144	139
Mastoid breadth	125	119	109	113	117	120	110	118	128	124	126	120	120	122	115	94	95	90	84	98	94
Palatal length	207	195	198	192	192	192	203	208	202	209	197	198	136	202	198	171	178	173	171	178	167
Palatal breadth at m^1	57	57	53	54	55	58	56	56	60	58	53	61	59	52	57	49	52	52	46	51	52
Upper toothrow, crown surface	89	85	95	88	92	95	91	92	84	92	86	88	94	90	86	85	89	94	86	83	90
Length of mandible, incisive border to angle	250	243	250	238	237	240	250	270	263	260	253	253	247	259	250	215	228	222	215	235	219
Angle to tip of coronoid	127	121	110	117	116	115	125	135	137	—	116	124	124	115	120	112	118	104	104	112	110
Depth at m^1	32	30	29	30	30	31	30	33	32	34	34	33	30	34	33	29	31	28	29	29	29
Length of lower toothrow	100	95	101	97	100	101	100	101	96	104	97	99	101	100	94	92	94	102	94	92	95
Diastema	86	73	83	81	77	79	86	90	92	90	84	84	82	90	82	70	72	71	66	75	70
Antlers, main beam to tip, along curvature	1130	984	950	890	950	826	807	1013	1120	1175	1205	1070	950	980	997	350	595	373	—	496	328
Antlers, greatest spread at point of palmation	503	676	670	655	650	414	465	362	775	791	652	608	593	623	701	140	362	280	—	—	117
Antlers, distance between tips of longest tines	179	90	417	292	445	145	290	—60[1]	792	283	227	90	197	196	258	100	212	245	—	—	122
Antlers, distance between points of main beam	159	537	520	593	515	295	409	223	797	772	505	333	560	—	643	150	258	275	—	—	243
Antlers, length of brow antler, ventral border	235	270	220	225	205	245	240	232	270	275	273	262	237	205	229	25	—	—	—	—	—
Antler, breadth of brow antler (transverse)	195	170	71	133	30	58	104	235	304	210	245	255	267	145	195	—	—	—	—	—	—
	m. w.	m. w.	s. w.	s. w.	m. w.	m. w.	s. w.	m. w.	m. w.	m. w.	m. w.	m. w.	s. w.	s. w.	s. w.	m. w.	m. w.	unw.	unw.	m. w.	m. w.

---

[1] Points overlap 60 mm. See Fig. 3.

The lower line of the table refers to the condition of the teeth, which indicates the comparative age of the specimen. Thus *m. w.* = teeth much worn; *s. w.* = teeth slightly worn; *unw.* = wholly unworn.

Measurements of Skulls of Rangifer arcticus and R. grœnlandicus.

	R. ARCTICUS										R. GRŒNLANDICUS.				
	22936	22985	22986	9498	19499	19500	19501	19505	19502	19503	10244	10195	10197	14236	14237
	♂	♂	♂	♂	♂	♂	♂	♀	♀	♀	♂	♂	♂	♀	♀
Total length (condylo-basal)	397	370	375	345	348	355	345	337	322	303	368	375	361	305	——
Tip of premaxillæ to tip of nasal	122	101	114	105	91	116	97	85	87	91	115	113	109	84	——
" " " " alveolus of p¹	143	135	131	114	120	124	121	108	106	105	138	122	119	99	——
Length of nasals	140	132	149	102	117	109	114	89	96	98	109	110	94	97	95
Breadth above m¹	147	119	105	104	112	112	106	96	98	97	119	112	116	104	103
Zygomatic breadth	146	136	134	134	133	134	132	112	125	126	139	141	144	126	127
Greatest breadth at orbits	178	165	169	163	165	162	158	147	153	147	173	163	169	152	154
Mastoid breadth	139	131	128	125	131	126	132	96	103	102	132	125	129	101	106
Palatal length	251	242	235	215	220	215	220	200	198	193	220	237	237	——	——
Palatal breadth at m²	64	64	59	59	58	58	58	53	55	53	71	63	67	56	55
Upper toothrow, crown surface	94	92	93	90	84	93	90	82	88	89	99	99	89	81	83
Length of mandible, incisive border to angle	312	295	290	272	272	283	280	250	255	240	276	275	284	256	247
Angle to tip of coronoid	145	123	136	134	131	135	126	118	120	115	138	149	145	115	123
Depth at m¹	36	31	33	31	33	36	32	28	30	29	25	34	33	28	33
Length of lower toothrow	96	92	102	92	93	97	95	87	93	93	——	95	103	96	91
Diastema	122	116	103	105	101	107	101	93	88	86	103	95	100	87	87
Antlers, main beam to tip, along curvature	1505	1235	1210	1175	1100	1062	795	340	275	245	1063	1115	1246	400	275
" greatest spread at point of palmation	1060	665	757	587	750	440	443	190	——	——	1020	918	993	255	——
" distance between tips of longest tines	625	315	533	400	498	200	423	168	——	——	775	533	560	——	——
" " " points at tip of main beam	725	286	567	287	640	333	340	222	250	——	725	650	690	65	——
" length of brow antler, ventral border	320	315	287	275	265	335	250	——	——	——	328	293	305	——	——
" breadth of " " (transverse)	226	197	167	190	139	250	183	——	——	——	120	190	195	——	——
	s. w.	m. w.	m. w.	s. w.	m. w.	s. w.	m. w.	m. w.	m. w.	m. w.	m. w.	unw.	s. w.	m. w.	m. w.

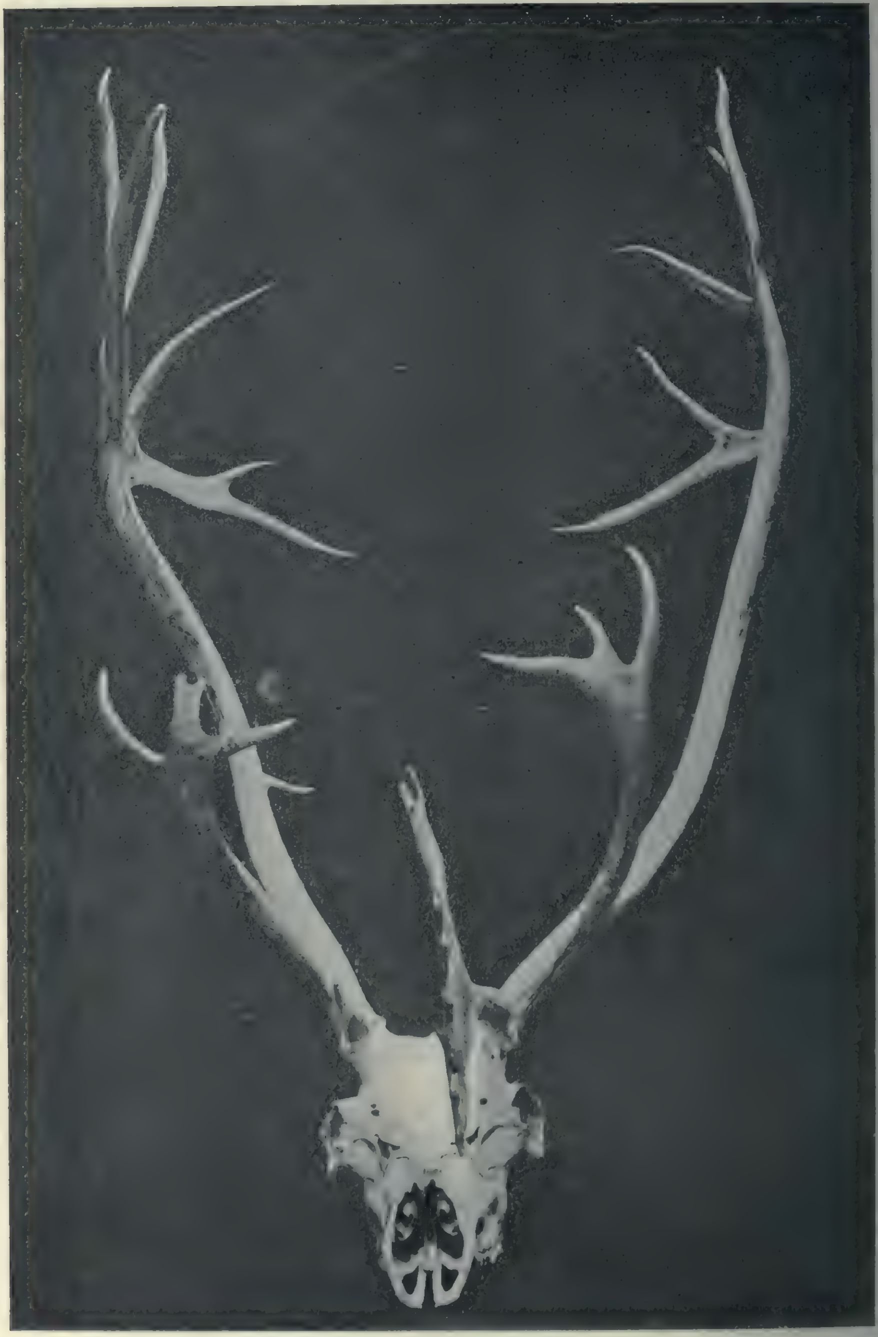


Fig. 1. *Rangifer pearyi.* No. 27987, near Lake Hazen, Grant Land, October, 1905; Commander R. E. Peary. About ⅕ nat size. Antlers of average size and form.

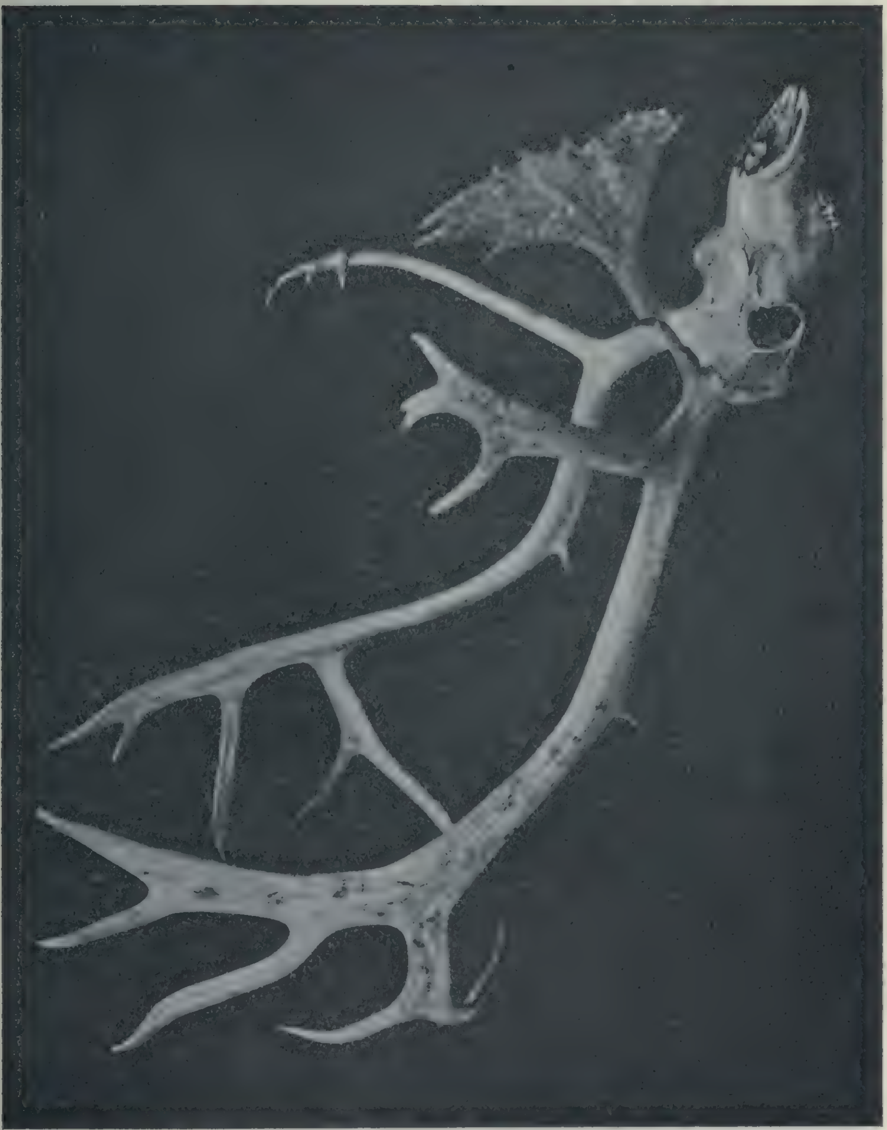
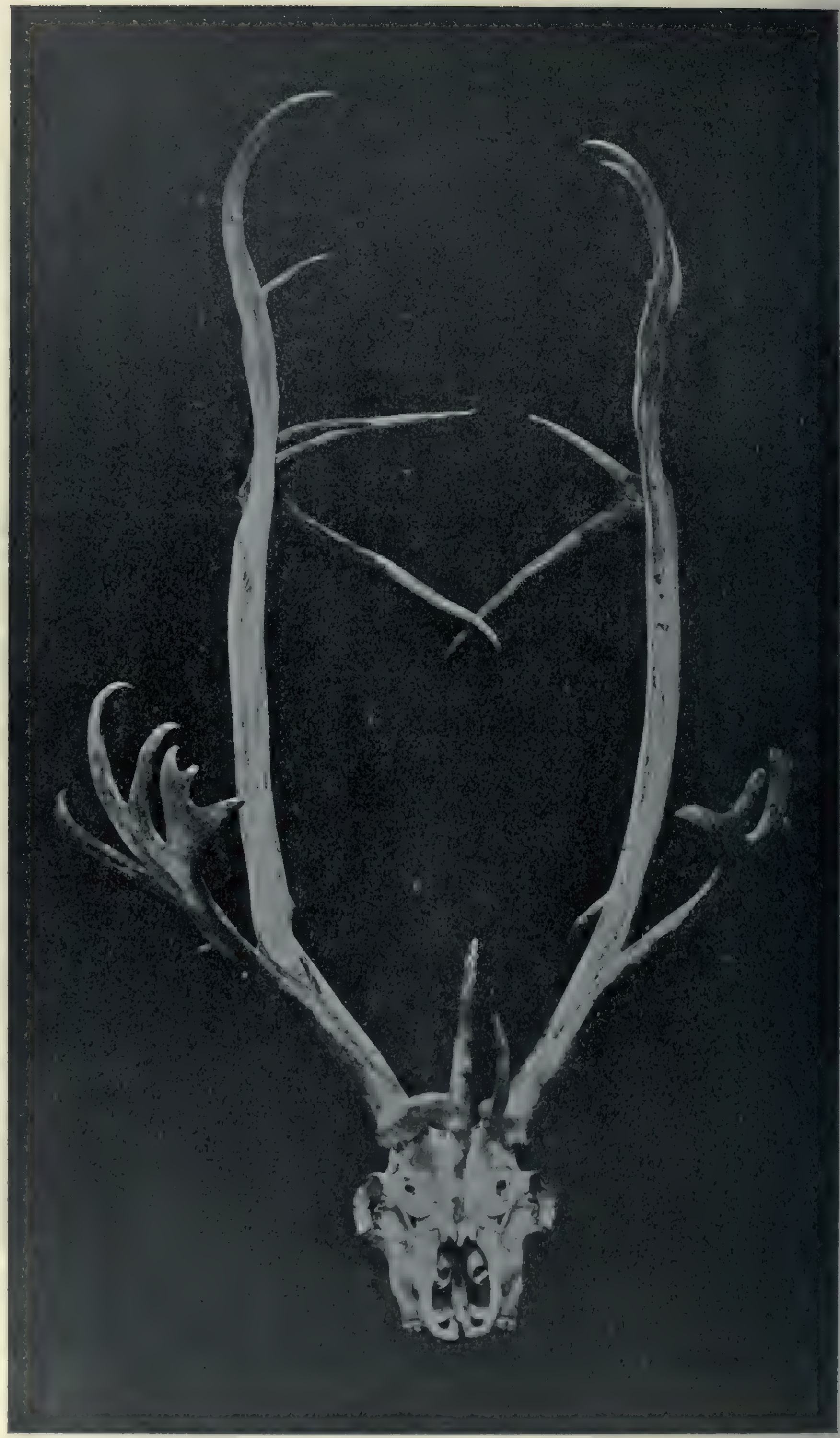


Fig. 2. *Rangifer pearyi.* Slightly oblique view of specimen shown in Fig. 1.



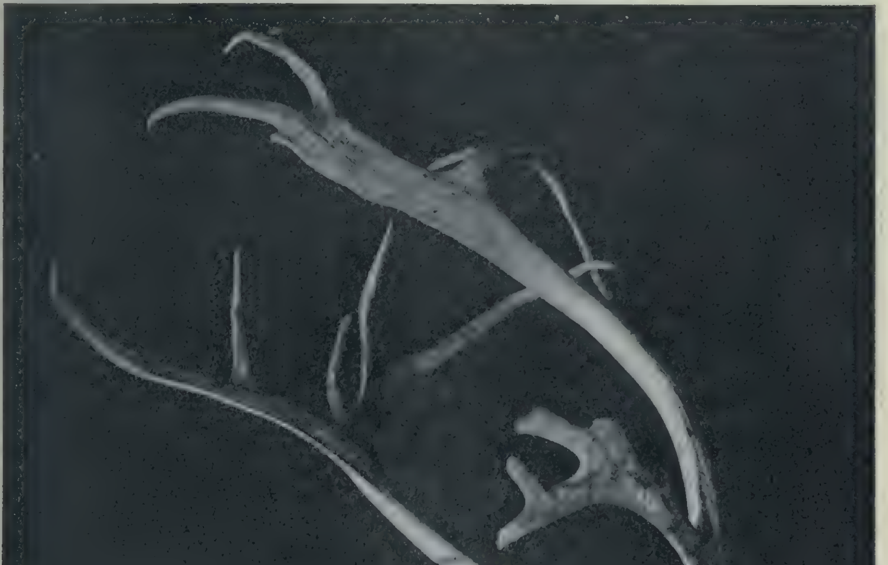


Fig. 4. *Rangifer pearyi.* Same specimen shown in Fig. 3,

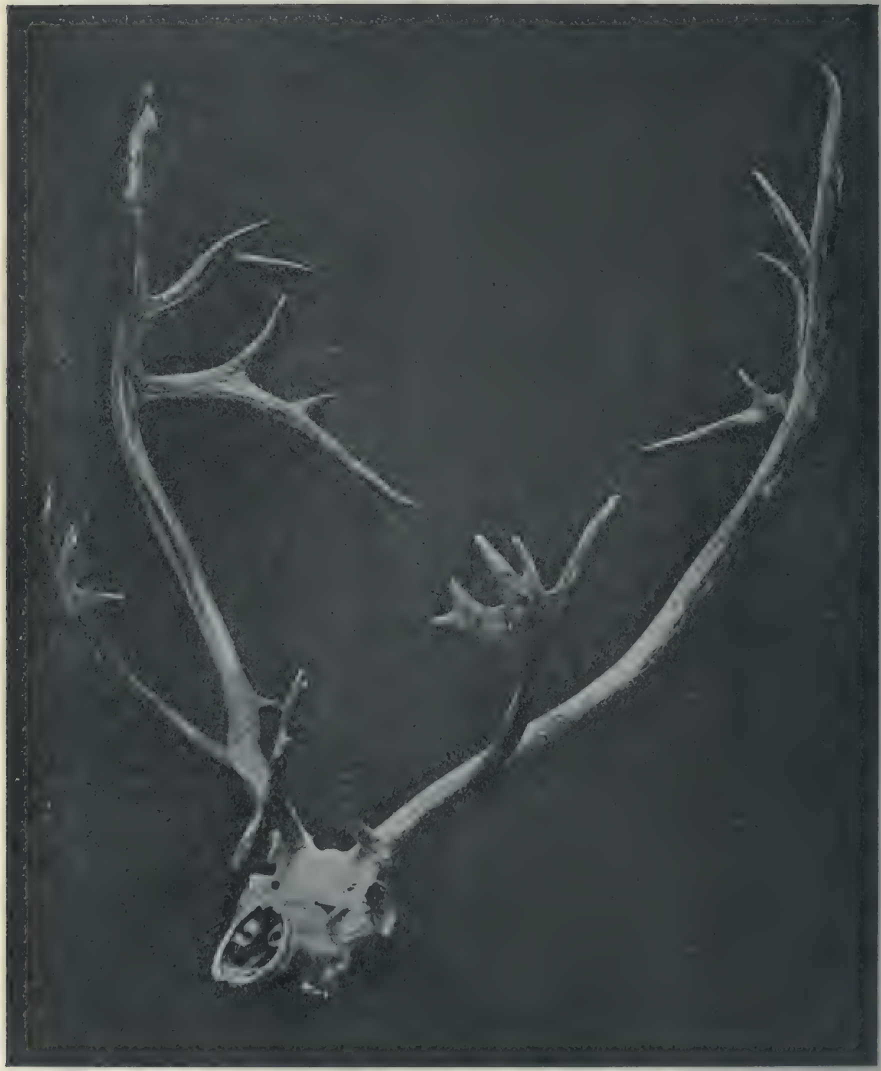


Fig. 5. *Rangifer pearyi.* No. 27939, near Lake Hazen, Grant Land, October, 1905; Commander R. E. Peary. About ⅛ nat. size. Antlers unusually divergent. (Compare with Fig. 3, showing unusually narrow spread, and with Fig. 1, of average or normal spread.)

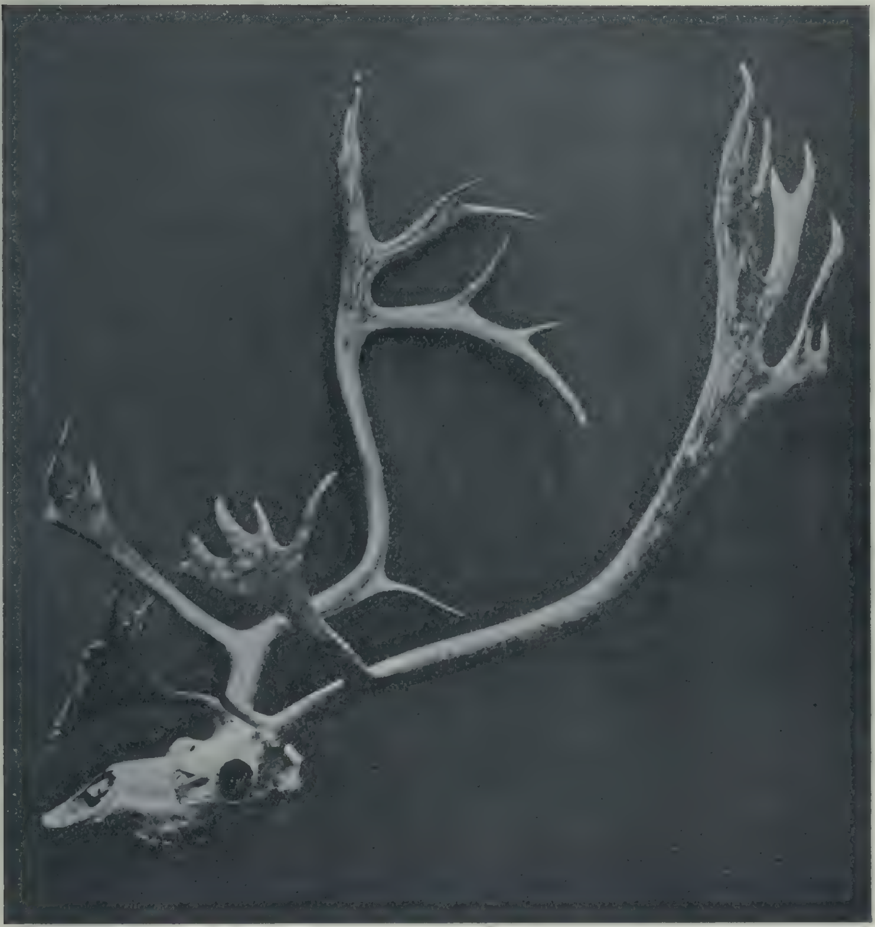


Fig. 6. *Rangifer pearyi.* Slightly oblique view of specimen shown in Fig. 5.

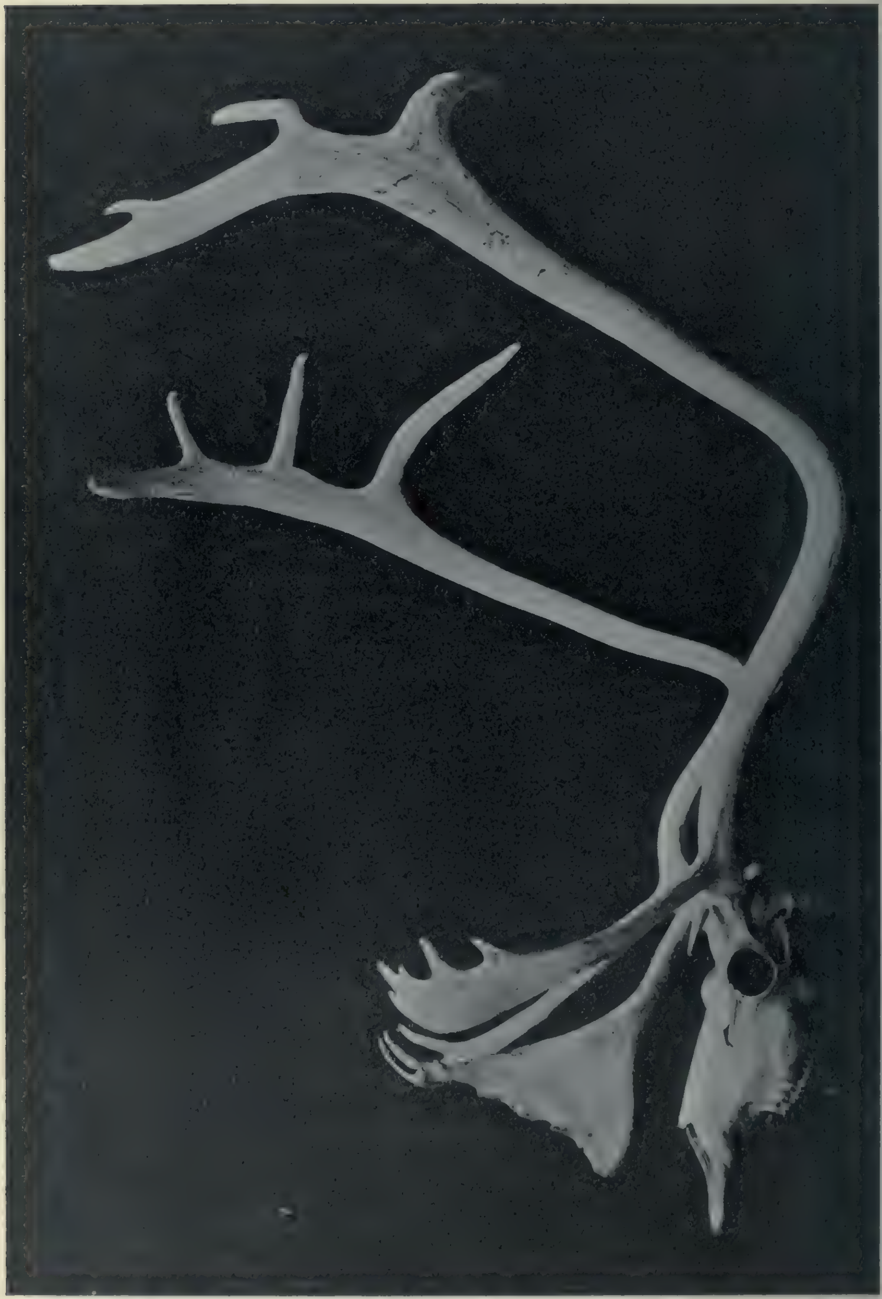


Fig. 7. *Rangifer arcticus.* No. 22936, Wager River, northwest coast of Hudson Bay; Captain George Comer. About ⅛ nat. size. Antlers of average size and form.

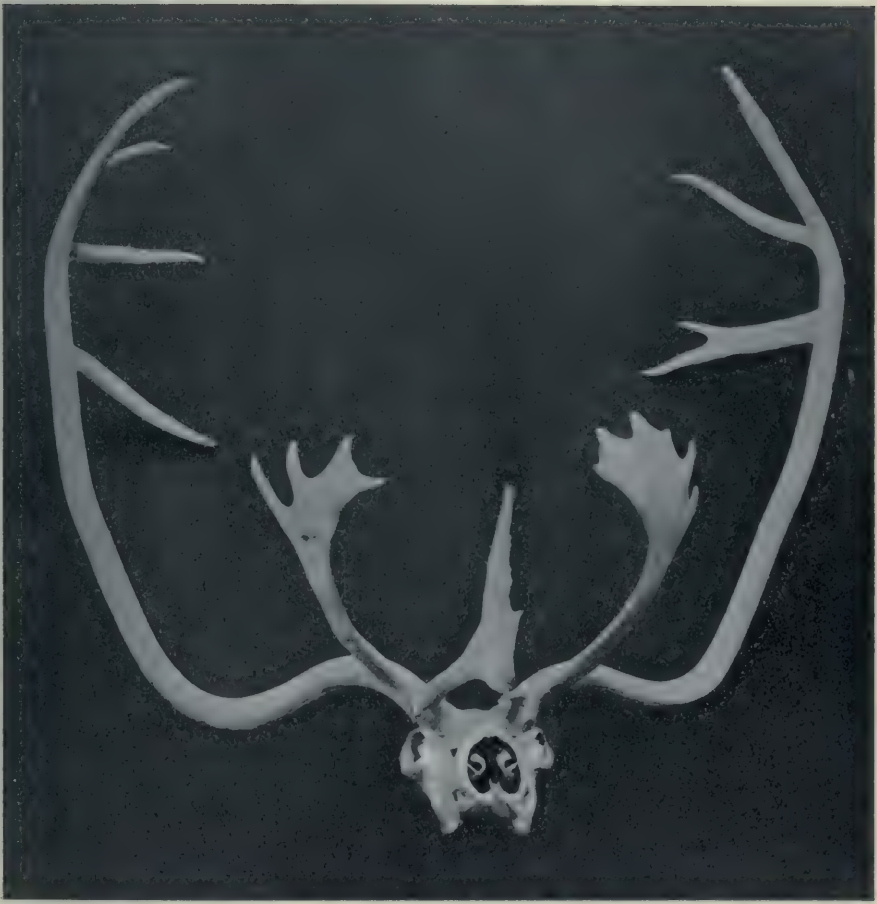


Fig. 8. *Rangifer arcticus.* Front view of specimen shown in Fig. 7.

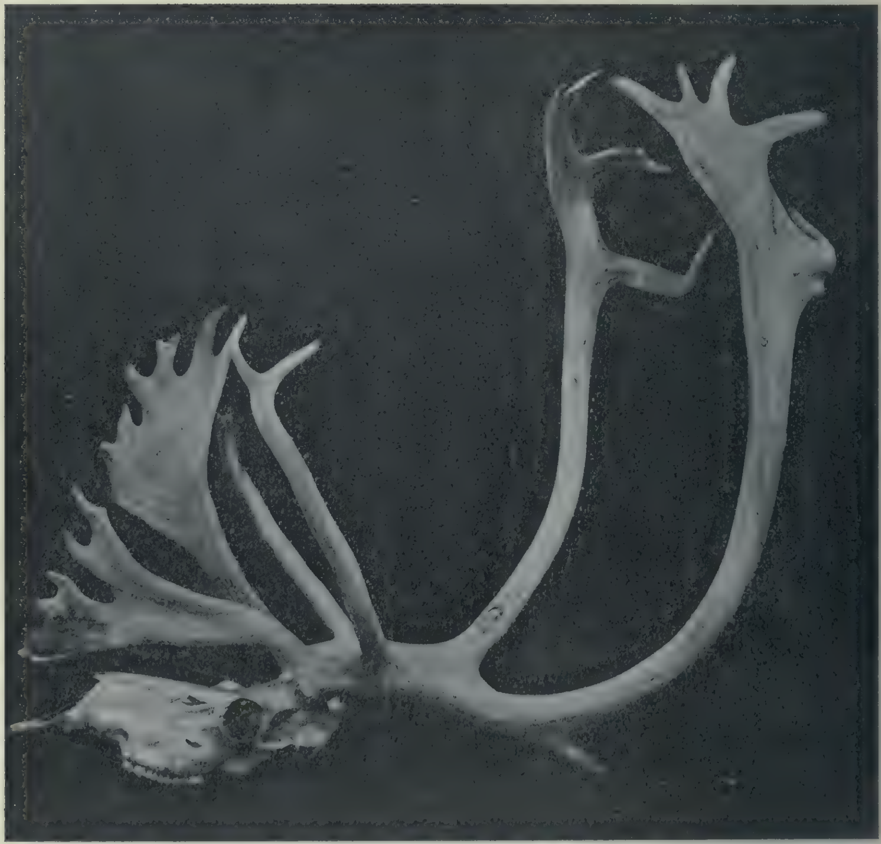


Fig. 9. *Rangifer arcticus.* No. 22985, Wager River, northwest coast of Hudson Bay; Captain George Comer. About ⅓ nat. size. A brow antler from both right and left antlers.

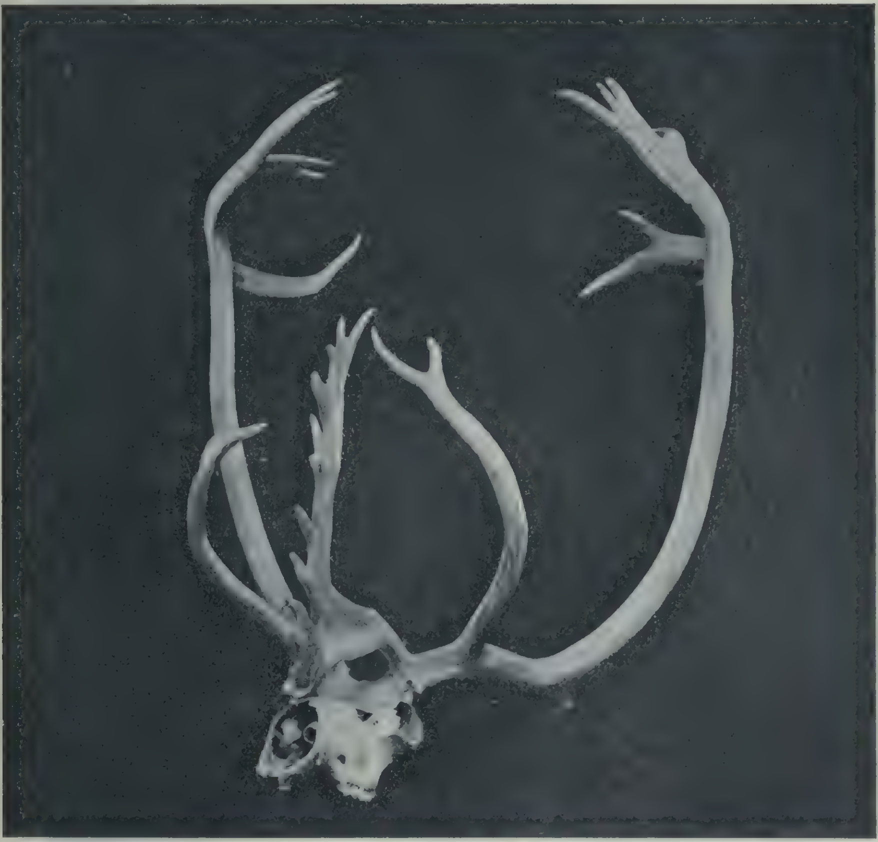


Fig. 10. *Rangifer arcticus.* Nearly front view of specimen shown in Fig. 9.

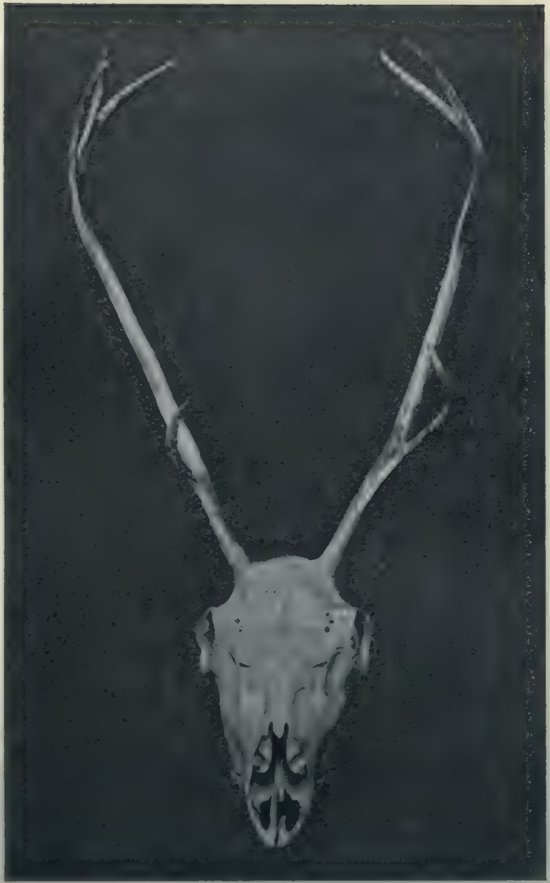


Fig. 11.

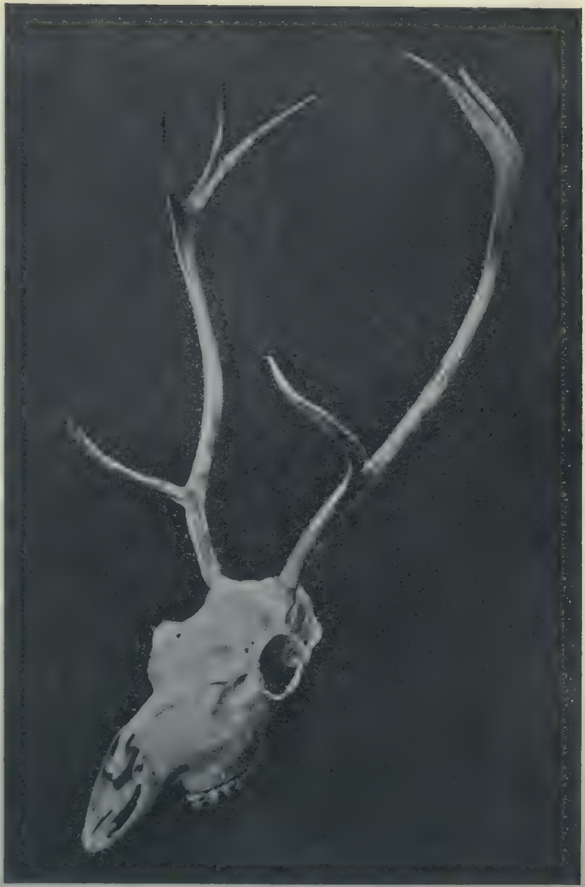


Fig. 12.

Fig. 11. *Rangifer pearyi.* No. 27914, adult female, near Lake Hazen, Grant Land, October, 1905; Commander R. E. Peary.

59.9, 33 S

Article XXIII.—NOTES ON *SOLENODON PARADOXUS* BRANDT.

By J. A. Allen.

Plates XXVIII–XXXIII.

The Museum has recently secured three specimens of *Solenodon paradoxus* Brandt, collected in San Domingo in 1907, by A. Hyatt Verrill, for the Kny-Scheerer Company, dealers in natural history specimens, of New York City. They comprise a very old male and a very old female,[1] preserved in formalin, both with the teeth much worn, and the complete skeleton of a young specimen still retaining the entire milk dentition. The two adult animals have been utilized for a group, the specimens having been very carefully modeled by Mr. Herbert Lang. The skin of the female was removed for mounting, the skeleton and most of the soft parts being preserved separately. Of the male only the skin of the head could be used for mounting, owing to its bad state of preservation, although the specimen is available for anatomical study. Hence the male is shown as peering from a hole in the artificial rock-work that forms the setting for the group. An illustration of this group, from a photograph, was published in 'The American Museum Journal' for February, 1908 (Vol. VIII, No. 2), and is here reproduced in Plate XXVIII.

A figure of the female, from a wash-drawing, from life, was published by Mr. Verrill (*l. c.*), with an account of its capture, external characters, habits, distribution, native names, etc. The other two specimens were captured by Mr. Verrill after the above account was prepared. The first specimen was taken "near El Cajon, and the other two near La Honda," localities not given on ordinary maps, but situated in the eastern part of the Republic.

Mr. Verrill states that "the animal was well known to the natives in certain isolated localities, but that over the greater portion of the Republic it was absolutely unknown. This is readily accounted for by the presence of the mongoose in most parts of the country, and it is only a question of time when this pest will overrun the entire island and the Solenodon will become actually exterminated."

---

[1] This is the specimen figured and described by Mr. Verrill in his 'Notes on the Habits and External Characters of the Solenodon of San Domingo (*Solenodon paradoxus*),' published in the 'American Journal of Science' for July, 1907 (4th ser., Vol. XXIV, pp. 55–57, with a half-tone figure in the text), and also in the 'Annals and Magazine of Natural History' for the same month (7th ser., Vol. XX, pp. 68–70, pl. iv).

Great credit is due Mr. Verrill for persevering in his special quest for this animal until success rewarded his efforts, for its discovery seemed at the outset almost hopeless. Credit is also due to Dr. G. Lagai of the Natural Science Department of the Kny-Scheerer Company of New York, who for many years has taken great interest in securing specimens of Solenodon, and who engaged Mr. Verrill for this enterprise.

Mr. Verrill's account of the animal is the first that has appeared based on actual observation of the animal in life and in its natural surroundings. He says: "In its habits the Solenodon resembles a hog, rooting in the earth and cultivated grounds, tearing rotten logs and trees to pieces with its powerful front claws, and feeding on ants, grubs, insects, vegetables, reptiles, and fruit, and at times proving destructive to poultry. On several occasions it has been known to enter the houses in search of roaches and other vermin, and has been captured in rat-traps.

"It is strictly nocturnal, and spends the day in caves, holes in the coral limestone rocks and in hollow trees and logs. It is a slow, stupid creature. It is unable to run rapidly, but shambles along with the zigzag, sidewise motions of a plantigrade. It is doubtless owing to this that it obtained the native name of 'Orso' (bear).

"Its long snout and stout front feet, with their curved claws, and its thick, short neck, prove impediments to forward progress. According to the natives it is incapable of running straight. They also claim that when pursued it frequently trips itself and tumbles heels over head. When hunted with dogs it thrusts its head into the nearest hole or shelter and allows itself to be captured without resistance.

"The only specimen that I obtained was a female which was captured alive and uninjured. A few days after its capture it gave birth to three naked young. These the mother promptly devoured, and she died three days later."

Solenodon paradoxus was first made known to science by Brandt in a paper presented to the Academy of Sciences of St. Petersburg in December, 1832, and published the following year,[1] from a skin and imperfect skull received from Haiti. His description of the species is remarkably full and accurate, considering the nature of the material. This specimen remained unique until 1907, when the three specimens collected by Mr. Verrill (as noted above) were secured by this Museum. The single previously known specimen described by Brandt was restudied some thirty years later by Peters,[2] in comparison with his new species from Cuba (*Solenodon cubanus*), the original type of *S. paradoxus* having been loaned to him by the authorities of the St. Petersburg Academy for this purpose. All subsequent accounts of this species, down to 1907, have also been based on this unique original, including the discussion of the phylogeny and dentition of *Solenodon* by Leche in 1907,[1] to whom the skull was again entrusted by the authorities of the St. Petersburg Academy for investigation (Leche, *l. c.*, p. 4).

---

[1] De Solenodonte, novo mammalium insectivorum genere. By J. F. Brandt. Mém. de l'Acad. de St. Pétersbourg, II, 1833, pp. 459–478. Also separate, pp. 1–20, pll. i, ii.

[2] Über die Säugethiergattung *Solenodon*. By W. Peters. Abhandl. der Königl. Akad. der Wissenschaften zu Berlin, 1863 (1864), pp. 1–22, pll. i–iii.

As is well known, the genus *Solenodon* is an isolated type, represented, so far as known, by two species, one of which (*S. paradoxus*) is confined to Haiti, the other (*S. cubanus*) to Cuba. It is the sole genus of the family Solenodontidæ, which finds its nearest living representatives in the family Centetidæ, confined to Madagascar and some of its outlying islands, thus an equally isolated group. Both are commonly regarded as survivals of primitive types, whose ancestral history remains to be discovered.

The characters of *Solenodon* have become well known, especially through the labors of Dobson,[2] who has described not only the osteology and dentition, but the myology and visceral anatomy, based on *S. cubanus*; while its phylogeny and dentition have been especially considered by Leche,[3] who has also described and figured the milk dentition of *S. cubanus*.

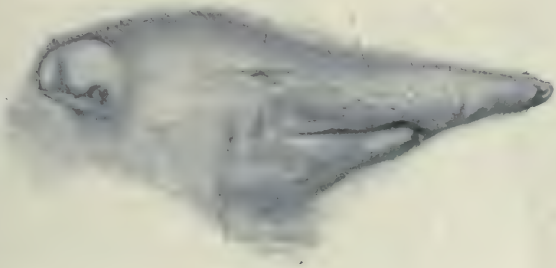


Fig. 1. *Solenodon paradoxus*. Side view of head of old male. Slightly less than ½ nat. size.

In external characters *S. paradoxus* and *S. cubanus* are in general quite similar, but they differ somewhat in size, and markedly in coloration, and also in some other features, as will be presently noted.

---

[1] Zur Entwichlungsgeschichte des Zahnsystems der Säugetiere zugleich ein Beitrag zur Stammesgeschichte dieser Tiergruppe. Von Wilhelm Leche. Zweiter Teil: Phylogenie. Zweites Heft: Die Familien der Centetidæ, Solenodontidæ und Chrysochloridæ. Mit 4 Tafeln und 108 Textfiguren. Zoologica, Heft 49. Stuttgard, 1907.

[2] A Monograph of the Insectivora, Systematic and Anatomical. By G. E. Dobson. Part I. Including the families Erinaceidæ, Centetidæ, and Solenodontidæ. 1882. (Solenodontidæ, pp. 87–96, pll. viii, ix.)

[3] *Op. cit.*, pp. 5–24 (*passim*), 55, 56, 144–146, pl. iv, figs. 55–58.

S. paradoxus may be described as follows:

The *nose* (from eye to tip of nose) is naked on the dorso-median area, and entirely so on the distal third, the short hairs of the facial region advancing laterally on the sides more than on the top; fore and hind feet naked, the bareness extending upward on the thighs to become confluent with the bare glandular area of the rump and lower back; tail naked.

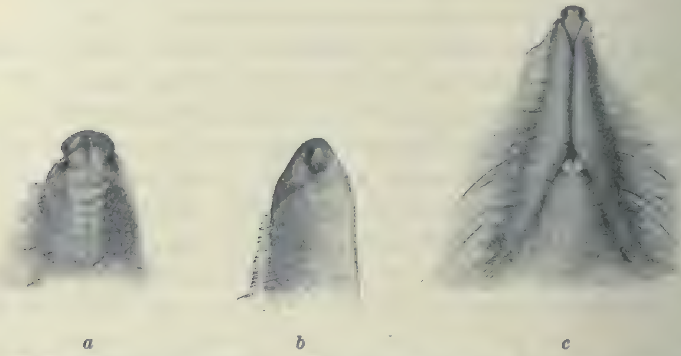


Fig. 2. *Solenodon paradoxus*, Three views of proboscis, ½ nat. size. *a*, from above; *b*, from side; *c*, from below.

The *nose-pad* (Figs. 1 and 2) is about 8 mm. wide at the extremity, produced dorsally about 5 mm., and extending ventrally in a V-shaped point for about 10–12 mm. The proboscis has a length of about 40 mm., and is supported at the base by a small plate of bone, joined to the premaxillaries by cartilage.

The *nostrils* (Figs. 1 and 2) are situated at the front lateral corners of the nose-pad, and are separated at the middle by a space of about 4–5 mm.

The *ear* is oval, obtusely rounded apically, the greatest width about equal to the length of the ear above the crown (Fig. 1).

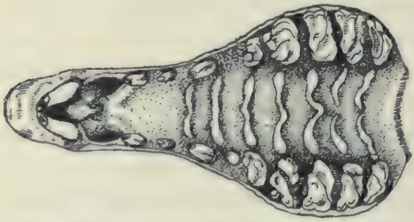


Fig. 3. *Solenodon paradoxus*. Palatal surface, showing number and character of the ridges. Nat. size.

The *tail* is naked, very finely and regularly annulated with small flat tubercles, from ½ to 1 mm. in transverse diameter; annulations about 1 to the millimeter on the basal half of the tail, becoming narrower apically, where there are 2 or 3 annulations to the millimeter.

The pelage is short, thin, and sparse, in comparison with that of *S. cubanus*, with much less underfur; the feet are less clothed, as is the face, and the naked, glandular area on the thighs and rump is more extended.

In *coloration* the female (in these two specimens) is brighter than the male. The general color of the median dorsal area is dusky brown, becoming lighter in front of the eyes, and laterally along the sides of the body and lower back; the hairs are lighter basally, and have lighter tips near the lateral and posterior borders of the dark dorsal area; sides light, tinged with fulvous, deepening to rufous on the shoulders, and to chestnut on the sides of the neck and sides of the head; throat and pectoral region darker, blackish chestnut; ventral surface pale rufous; a small oval white spot on the nape, about 8 × 15 mm. in extent.

The pelage of the male is, unfortunately, in bad condition, the hair having become in large part detached. The white nape spot present in the female (probably an individual variation) is apparently absent. The pattern of coloration is in other respects similar, but the tints are paler, the rufous especially much weaker in tone.

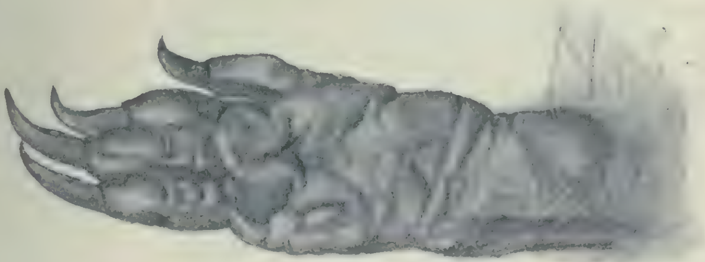


Fig. 4. *Solenodon paradoxus.* Left fore foot, from below, nat. size.

The interdental *palatal ridges* (Fig. 3) are apparently less strongly developed than in *S. cubanus*, as figured by Peters (*l. c.*, pl. ii, fig. 7), and cease about opposite p^1, instead of being continued forward to the base of the middle incisors, there being only 7 in *paradoxus* instead of 9 as in *cubanus*. In this respect the present specimens agree well with Brandt's figure (*l. c.*, pl. ii, fig. 5) of the type of *paradoxus*.

Mr. Verrill's description of the external characters, from the living animal, is of interest in the present connection, especially his references to the sparseness of the pelage, and the color of the naked parts of the animal, which is as follows:

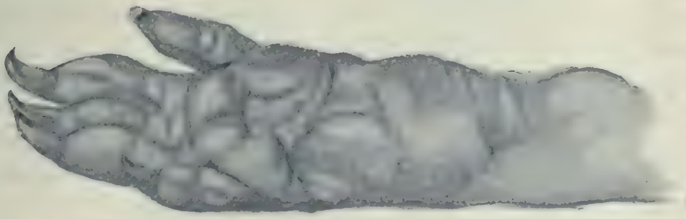


Fig. 5. *Solenodon paradoxus.* Left hind foot from below, nat. size.

"The body and head are covered with sparse, coarse hair, which is reddish ferruginous from the eyes to the shoulders, and dusky brown on the rest of the body.

"The hair becomes very thin and scattered on the hind quarters, which for some distance on the back and sides are naked, roughly corrugated, and warty, with a sparse, short, wooly growth between the excrescences.

"The legs, snout, and eyelids are naked and with the bare skin of the rump are pinkish white. The ears are short, thin, rounded, and are bluish gray with light edges. The heavy, rat-like tail is dark brown and naked. The claws are horn color. The front feet and claws are large, heavy, and mole-like and well adapted to digging and tearing asunder rotten wood, etc. They are much smaller in proportion than in the Cuban species, however. The snout is also more flexible than in *S. cubanus*, from which it also differs in the smaller extent of the naked skin of the rump, the color, size, and other characters."

I am indebted to Mr. Herbert Lang for the subjoined external measurements. Those of the male (see Table II) were made in the same detail as those given by Dr. Peters of the type (female) of *Solenodon cubanus* (*l. c.* pp. 5, 6), for convenience of comparison. Unfortunately the female specimen was dismembered before the importance of securing detailed measurements for comparison with those of the type of *S. cubanus* was recognized.

I. External Measurements of *Solenodon paradoxus*.

	♂ mm. No. 28270	♀ mm. No. 28271	mm. Type[1]
Total length in straight line	535	510	520
" " along curvature of body	586	555	—
Length of tail	241	220	230
" from calcaneum to tip of middle claw . . .	71	69	—
" " olecranon to " " " " . . .	104	104	—
" of the muzzle in front of the incisors . . .	39	40	—

The above measurements show that in these two specimens the male considerably exceeds the female in size. The female is somewhat older than the male, having the teeth rather more worn, but both are what may be termed 'old adults.'

Dobson states that an adult male *Solenodon cubanus* in the Paris Museum, and another male in the Hunterian Museum are both somewhat smaller than the type of the species, a female, as described by Peters, "whence," he says, "we may, perhaps, infer that the male is somewhat smaller than the female." Peters's specimen, as shown by his figures of the skull, was a middle-aged animal, with the teeth wholly unworn; compared with a female skull in the U. S. National Museum Collection (No. 37983), of apparently about the same age, it is decidedly larger (see measurements of skulls in Table II), and also larger than a second skull in the U. S. National Museum Collection (No. $\frac{2230}{1398}$), also a female (see Table II); from this we may, perhaps, infer that Peters's specimen was an exceptionally large female, and that the males mentioned by Dobson had not attained full size, although "apparently quite full grown." The figure given by Dobson of the Hunterian

---

[1] From Brandt, *l. c.*

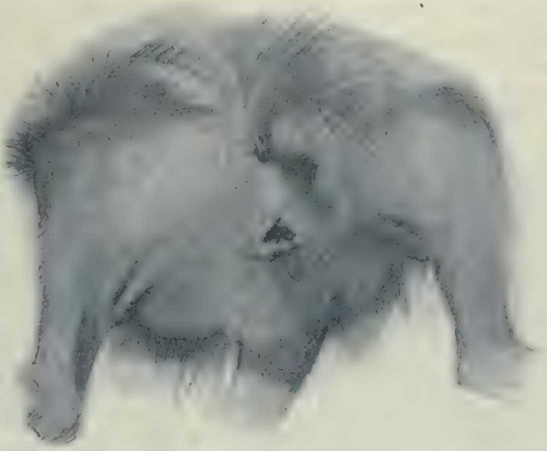


Fig. 6. *Solenodon paradoxus.* Male genitalia. ½ nat. size.

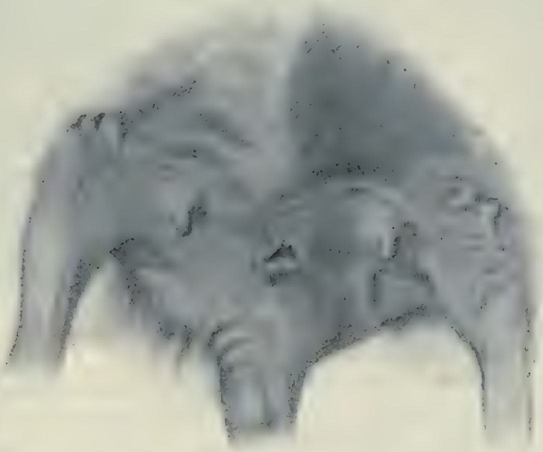


Fig. 7. *Solenodon paradoxus.* Female genitalia. ½ nat. size.

specimen shows it to have been moderately young; in the old age stage it would certainly have been notably large.

II. Comparative External Measurements of *Solenodon paradoxus* (♂) and *S. cubanus* (♀).

	paradoxus ♂[1] mm.	*cubanus* ♀[2] mm.
Length from end of nose to base of tail (in curved line over the back	343	340
Length from end of nose to anus (in straight line)	282	280
Length of head (in straight line)	119	117
Breadth of head in front of ears	45	50
Distance from eyes to point of nose	72	67
Length of eyelids (fissure)	4	3
Distance of eyes from each other	30	29
Distance from eye to ear	30	28
Distance between ears at base	44	42
Height of ear	28	30
Breadth of ear	26	25
Length of proboscis to incisors	39	35
Breadth of proboscis at base	22	18
Breadth of proboscis at middle	14	10
Height of proboscis at base	19	16
Height of proboscis at middle	12	10.5
Length of muzzle (hairless part) on lower side of proboscis	12	10
Distance from point of under lip to corner of mouth	28	31
Distance between corners of mouth	30	30
Length of tail	241	190
Thickness of tail at middle	12.5	11
Length of *hand* to end of third digit (without claws)	41	43
" " 1st digit (without claw)	8	8.5
" " claw of 1st digit (over curvature)	9	9.5
" " 2d digit (without claw)	14	16
" " claw of 2d digit (over curvature)	16	29
" " 3d digit (without claw)	17	17.5
" " claw of 3d digit (over curvature)	17	26
" " 4th digit (without claw)	15	17
" " claw of 4th digit (over curvature)	12	28
" " 5th digit (without claw)	11	12
" " claw of 5th digit (over curvature)	9	16
" " *foot* to end of middle digit (without claw)	62	56
" " 1st digit (without claw)	8	10
" " claw of 1st digit (over curvature)	7	8
" " 2d digit (without claw)	11	15
" " claw of 2d digit (over curvature)	9	9.5
" " 3d digit (without claw)	12	15
" " claw of 3d digit (over curvature)	10	9.5
" " 4th digit (without claw)	11	15
" " claw of 4th digit (over curvature)	9	9
" " 5th digit (without claw)	10	14
" " claw of 5th digit (over curvature)	8	8.5

---

[1] No. 28270, Amer. Mus., ♂, *Solenodon paradoxus*. Measurements taken by Herbert Lang from specimen preserved in formalin.

[2] Type of *Solenodon cubanus* Peters. Measurements from Peters, *l. c.*, pp. 5, 6.

In external characters *S. paradoxus* and *S. cubanus* present a number of noteworthy differences, as in the relative length of the tail, the relative development of the fore claws, in coloration, and in the character of the pelage, as follows: *S. paradoxus* is slightly the larger (much larger if the comparison is based on the skulls); the tail is relatively about one fourth longer (see Table III), and the fore claws nearly one half shorter and correspondingly weaker.

In coloration *S. paradoxus* has the dorsal area lighter than *S. cubanus*, but the chief difference is in the color of the head, sides of the neck, shoulders, and throat, which in *cubanus* are light yellow, golden yellow, or light ocher yellow, as described by Peters, Gundlach, Poey, and Dobson, or nearly pure white, as in two alcoholic specimens in the U. S. National Museum collection (Nos. 15526, adult female, and 15527, quarter-grown young, possibly somewhat faded), in abrupt contrast with the color of the back; in *paradoxus* the head is lighter colored than the dorsal area, but is not in

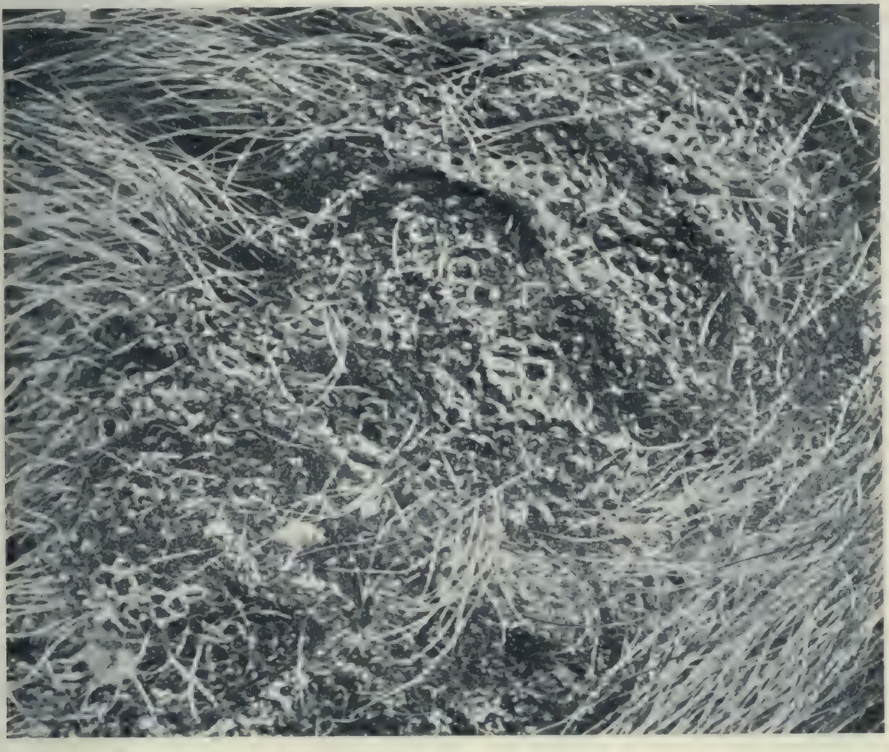


Fig. 8. *Solenodon paradoxus.* Glandular surface of left thigh. About $\frac{4}{1}$.

abrupt contrast with it; the dark rufous of the head becomes somewhat lighter anteriorly, but on the sides of the neck, shoulders, and breast passes into deep rufous chestnut, very unlike the light yellow of these parts in *cubanus.*

The pelage is much heavier — longer and thicker — and more woolly in *cubanus* than in *paradoxus,* in which latter species the nose, facial region and feet are also much more thinly clothed.

The well marked differences in the skull and teeth, noted below, have long been known, and show that instead of the two forms being only "local varieties," as suggested by Dobson, they are really not closely related, and might well be regarded as referable to different subgenera.

TABLE III. COMPARATIVE MEASUREMENTS OF SKULLS OF *Solenodon paradoxus* AND *S. cubanus.*

	S. paradoxus.			*S. cubanus.*			
	♂[1]	♂[2]	♀[3]	♀[4]	♀[5]	♀[6]	♂[7]
	mm.	mm.	mm.	mm.	mm.	mm.	mm.
Occipito-nasal length	—	87	88	77	80	87	—
Condylo-basal length	—	79	76	73	75	—	—
Basal length	74.3	75	72	69	71	73.7	69.9
Basilar length	—	69	67	62	62.5	—	—
Palatal "	44	44	43	41.5	43	45	43.2
Palatilar "	—	38	37	34	34.5	—	—
Breadth at zygom. proc. of maxilla .	31.5	36	34	31.5	31.5	34.7	—
" " " " " squamosal .	30.3	36	31	31	32.5	33.5	31.7
Interorbital breadth	17.7	15	15	15.2	15	19.6	15.2
Mastoid "	—	28	27.3	26.3	27	—	—
Breadth of occip. condyles	—	17	17	15.6	17	—	—
Breadth (transv.) of occip. crest . .	—	20.5	20	19.7	17.2	—	—
Breadth of rostrum at ant. border . .	—	9	9	7.2	7.6	—	
" " " " canines . .	?8.7	12	12	10	10	?9.4	—
Distance outside to outside of third molars	23	22	22	18	18.2	12	—
Palatal border to foramen magnum .	—	30	30	27	27.3	—	—
" " " hamular process .	—	10	10	11.3	—	—	—
Length of upper toothrow	39	40	39	35	36	39	38.1
Space occupied by incisors . . .	—	13.5	14	11.2	11	—	—
" " " c–p $^{1-3}$ . . .	—	16	15	14.7	15	—	—

---

[1] *S. paradoxus.* Type, ♂. Measurements from Peters, *l. c.*, pp. 11, 12.
[2] *S. paradoxus,* old ♂, No. 28270. Measurements from the specimen.
[3] *S. paradoxus,* old ♀, No. 28271. Measurements from the specimen.
[4] *S. cubanus,* ♀, No. 37983, U. S. Nat. Mus. Measurements from specimen.
[5] *S. cubanus,* ♀, No. [illegible] U. S. Nat. Mus. Measurements from specimen.
[6] *S. cubanus,* Type, ♀. Measurements from Peters, *l. c.*, pp. 11, 12.
[7] *S. cubanus,* ♂, Hunterian Museum. Measurements from Dobson, 'Monograph of the Insectivora,' p. 90.

(*Table III continued.*)

Space occupied by p^3–m^3 . . .	15.3	15.5	16	12	12	12.2	—
" " " molars . . .	—	10	10.3	7.5	7.7	—	—
Lower jaw, length (to angle) . . .	—	56.6	55	49.6	50		
" " height at condyle . . .	—	13.5	14	12	7.3	—	—
" " " " coronoid . . .	25.5	25.2	26	23	24	28	25.4
Length of lower toothrow	33	36	35	32	32.4	30.5	33
Space occupied by incisors	—	7	7	7	7	—	—
" " " c–p_{1-3}	—	15	15	14	15	—	—
" " " molars	—	13	13	10	10.3	—	—
" " " p_3–m_3	17	17	17.3	13.6	14	15	—

In cranial characters and dentition, as long since pointed out by Peters (*l. c.*), the two species are exceedingly distinct. *S. paradoxus* has a much larger, heavier, and more massive skull, both relatively and absolutely, in comparison with the general size of the animal, as is well shown in Plates XXIX–XXXI. The posterior rudiment of the zygomatic arches is much more developed and ends in a long slender point, in one of the three known adult skulls, but is less developed in the others. The interpterygoid fossa in *paradoxus* is shallow, and much *wider in front* than posteriorly; in *cubanus* it is much deeper and one third to one half *narrower in front* than posteriorly; and the pterygoids are not only broader in *cubanus* but extend much further back, and the hamular processes are also much more developed and more posterior in position. The interorbital region is relatively much broader in *cubanus*. In *S. paradoxus* the proboscis is supported at base by a bony subquadrate plate,[1] 5 mm. wide and 4 mm. long (in the old female; slightly smaller in the somewhat younger male), which is wholly lacking in *S. cubanus*, or merely represented by somewhat hardened or 'horny' cartilage. In other features of the skull the two species show close resemblance.

The differences in dentition are correlated with those of the skull, the individual teeth being about twice as massive in *paradoxus* as in *cubanus*, but have the same details of form. The intervals, however, between i^1 and i^2, and between i^3 and the canine, are somewhat greater in *cubanus* than in *paradoxus*.

Neither of the two skulls of *S. cubanus* before me shows any palatal vacuity, the palatal floor being uniformly ossified throughout (excepting, of course, the usual foramina); in *S. paradoxus* both adult skulls show a very small longitudinal vacuity in the palatines, but they look more like accidental fractures than normal vacuities. As the young skull of *S. paradoxus* has the palatines completely ossified, it seems probable that this is the normal condition. The female skull of *S. paradoxus* has a very large vacuity on each side of the basal third of the rostrum (see XXXI, Fig. 1), but as such vacuities are absent in all other known skulls of *Solenodon*, they are evidently abnormal or pathological.

---

[1] Called 'os proboscidis' by Brandt, by whom it is well described and figured.

In correlation with the heavy ossification of the skull and the presence of an 'os probocidis' in *S. paradoxus*, the hyoid bones and all of the laryngial cartilages are densely ossified (Fig. 9).

The milk-dentition in *Solenodon* has been described and figured by Lesche,[1] on the basis of *S. cubanus*, but his illustrations do not form a very satisfactory basis for comparison, only a lateral view of the teeth being given, without any indication of the maxillary-premaxillary suture. The figures indicate slight differences in the form of the teeth from what is seen in *S. paradoxus*. His descriptions are comparative with the milk-dentition of the Centetidæ, and are thus not definite and detailed.

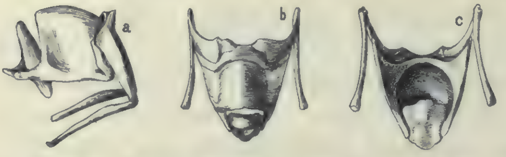


Fig. 9. *Solenodon paradoxus.* Hyoid bones and ossified larynx. Nat. size.

All the milk teeth of the upper mandible were present and in place except the canine and dp^3, which had fallen out by masceration, but were preserved. The permanent tooth is visible at the bottom of the sockets, in each case. The canine and dp^3 were, however, easily replaced, and are shown *in situ* in Plate XXXII. The formula of the milk dentition is I $\frac{3}{3}$, C $\frac{1}{1}$, P $\frac{3}{3}$ = $\frac{7}{7}$ = 14. Id^1 is not larger than id^2 or id^3, but differs from them in shape, being three-sided, with the inner face convex, and the longer diameter transverse to the axis of the premaxillæ. Pd^3 is slightly larger than pd^2; both are conical, with a well developed cingulum. The maxillo-intermaxillary suture separates dp^3 and the canine. The canine is similar in form to the adjoining incisor and slightly smaller; consequently many times smaller than the permanent canine. Dp^1 is similar in form to p^1 and nearly as large; dp^2 is about one half the size of p^2 and of similar form. Also dp^3 has the same form as p^3 and is about two thirds as large.

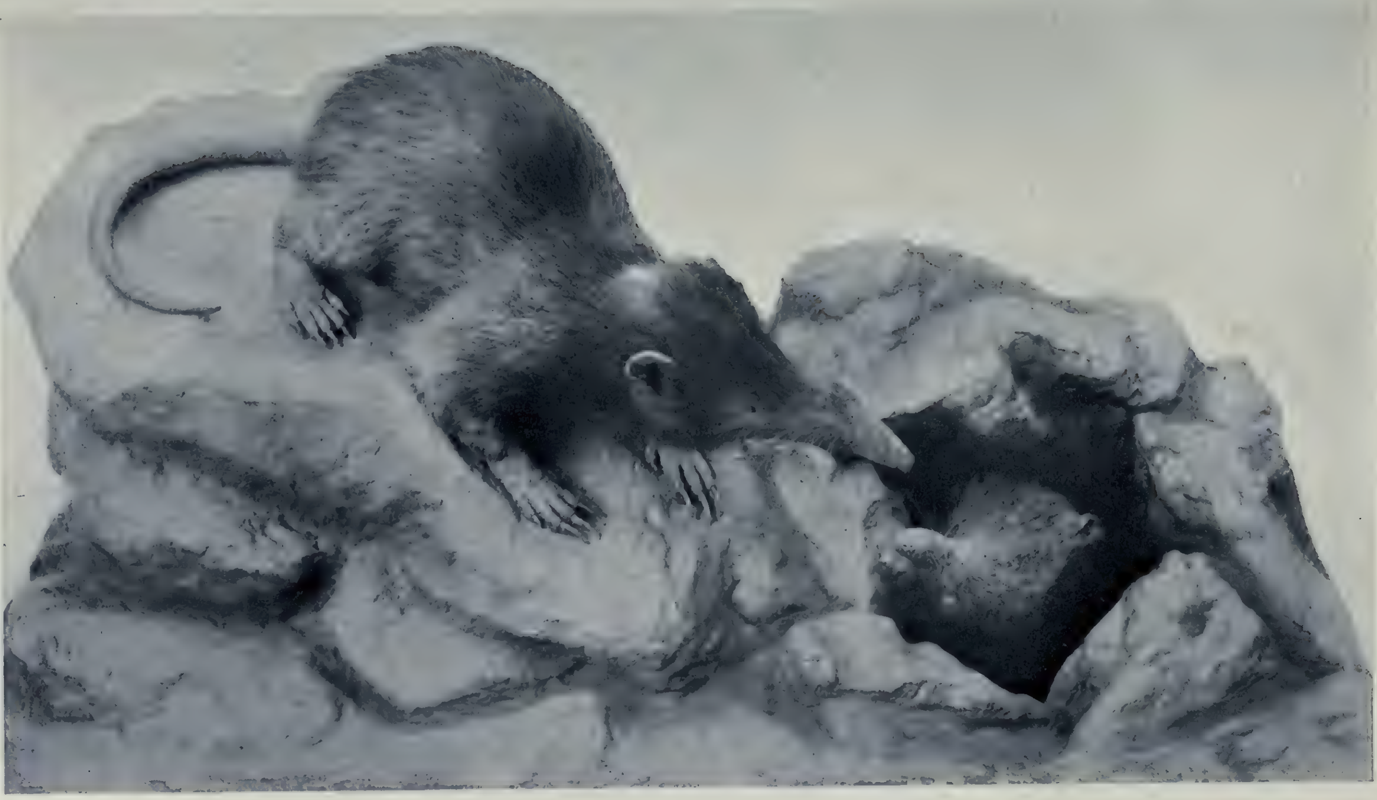
In the lower jaw id_1 and id_3 have the same form and nearly the same size as i_1 and i_3; but dp_2 is a small tooth, rather long, laterally flattened and sharp-edged, but wholly lacks the inner groove so conspicuous in i_2, and is only about one tenth as large. Cd is very small — a mere point, while pd_1 is nearly as large as p_1 and of the same form; dp_1 has fallen out and its successor protrudes above the alveolus; it has been preserved and is a minute conical tooth (not shown in the photograph, Pl. XXXII); dp_3 is a relatively large tooth, similar in form to p_3, but about one half smaller.

---

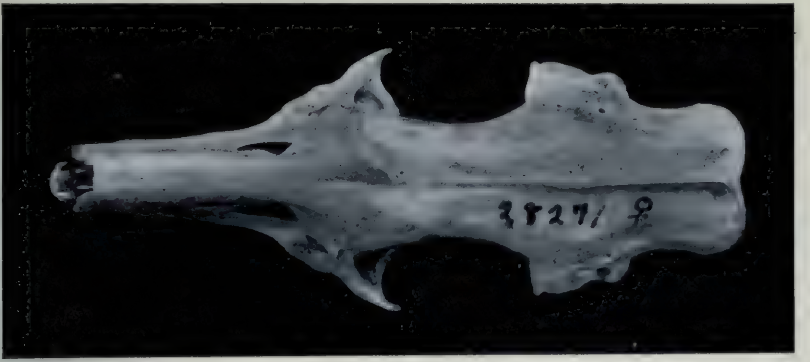
[1] Enwicklungsgeschichte des Zahnsystems der Säugetiere, Part II, Heft 2, 1907, pp. 55, 56, pl. iv, figs. 55, 56.

As complete ankylosis of the bones of the skull in *Solenodon* occurs quite early in the life of the animal, photographs of a young skull of *S. paradoxus* are here given (Plate XXXIII) showing the principal sutures at the stage when the milk dentition is still in situ.

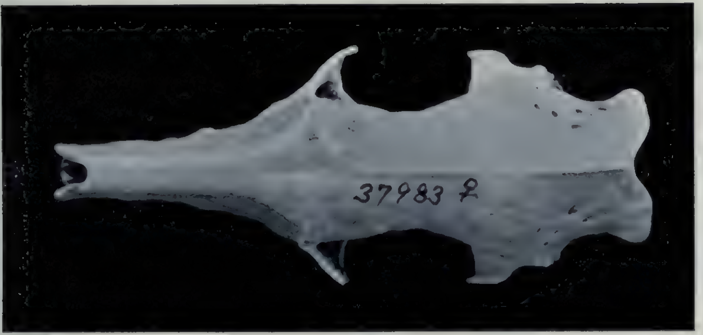
For use of specimens of *Solenodon cubanus*, for comparison with *S. paradoxus*, I am indebted to the kindness of the authorities of the U. S. National Museum, through Dr. Frederick W. True, Head Curator of the Department of Biology. These specimens comprised two examples in alcohol, No. 15526, ♀ ad., and No. 15527, ♂ juv., about one fourth grown, from the Sierra Maestra, Cuba, collected by the late Dr. Juan Gundlach; also an adult female skull (No. 37983, from No. 15526, in alcohol) and another adult female skull (No. $\frac{2230}{1398}$), with locality simply "Cuba, Prof. Poey."



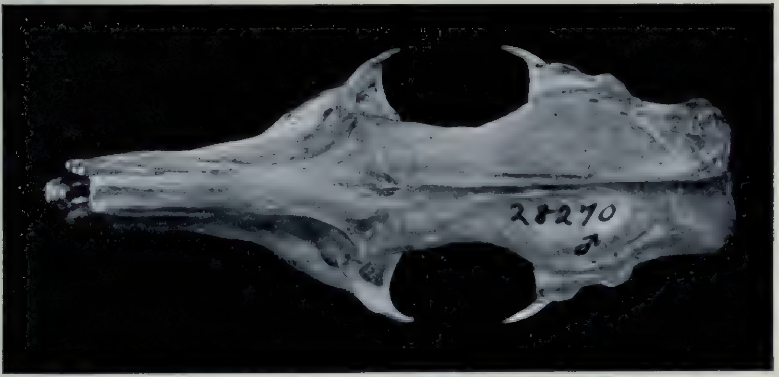
SOLENODON PARADOXUS.
Mounted Group at American Museum.



1.



2.

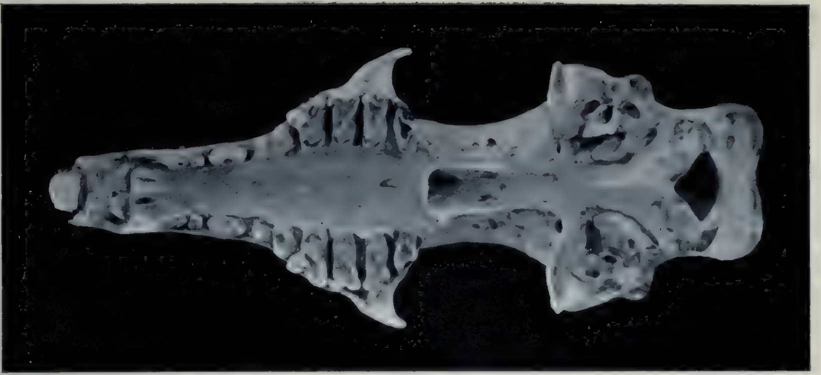


3.

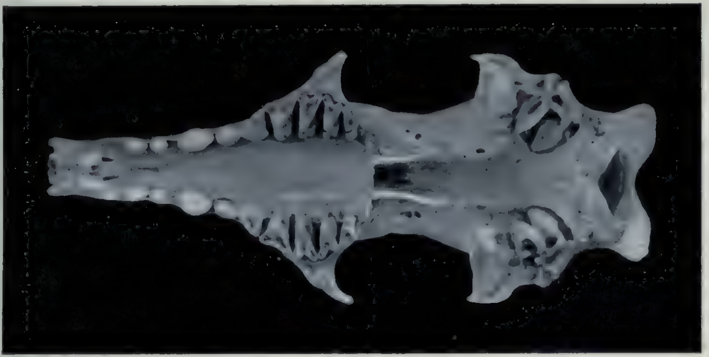
SOLENODON.

Figures natural size.

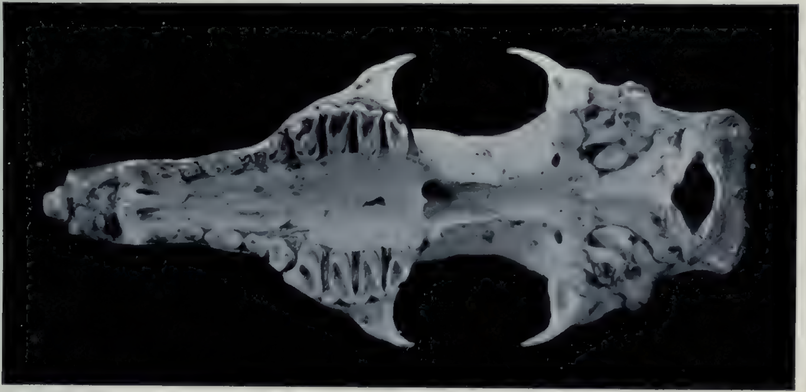
Fig. 1. *S. paradoxus*, Am. Mus. No. 28271, ♀.
Fig. 2. *S. cubanus*, U. S. Nat. Mus. No. 37983, ♀.
Fig. 3. *S. paradoxus*, Am. Mus. No. 28270, ♂.



1.



2

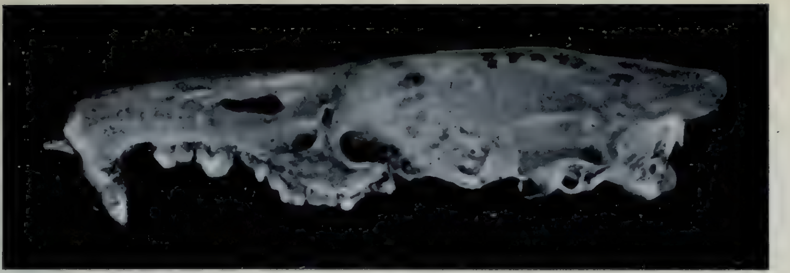


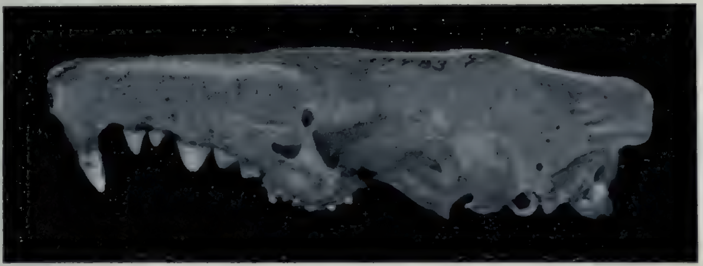
3.

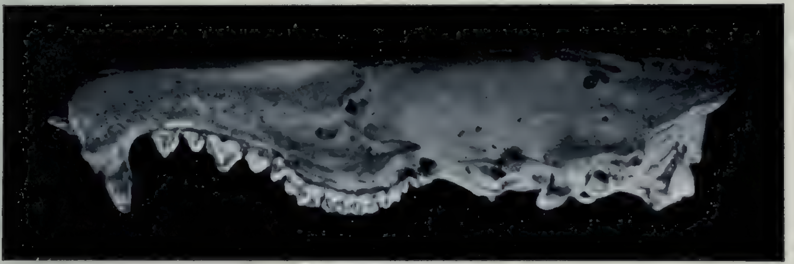
SOLENODON.

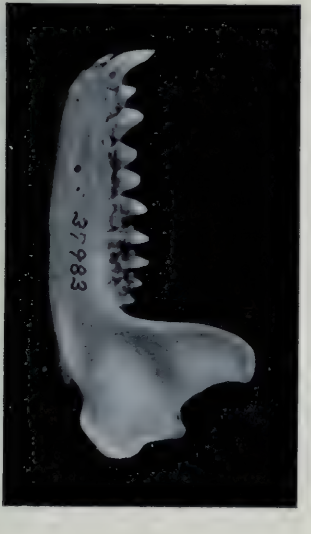
Figures natural size.

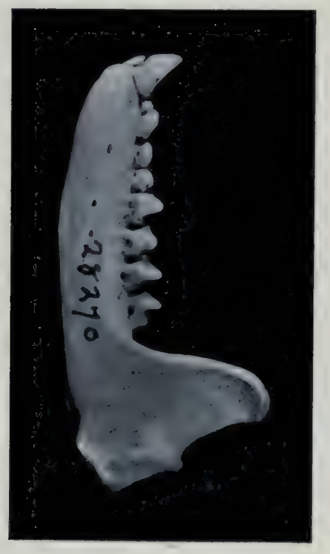
1. *S. paradoxus*, No. 28271, ♀.
2. *S. cubanus*, No. 37983, ♀.
3. *S. paradoxus*, No. 28270, ♂.

1


2


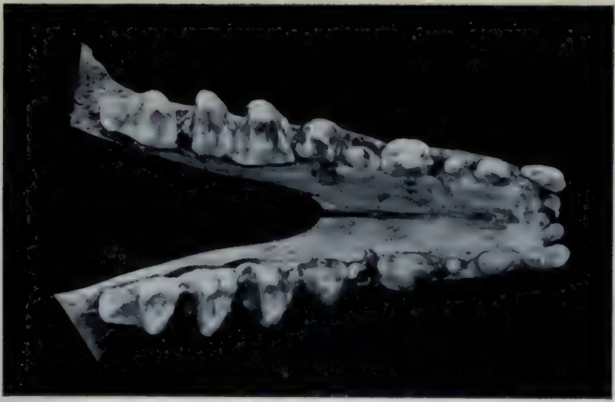
3


4


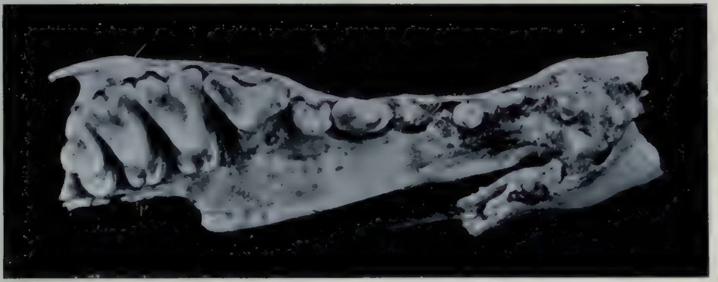
5


1. *Solenodon paradoxus*, No. 28271, ♀. 2 and 4. *S. cubanus*, No. 37983, ♀. 3 and 5. *S. paradoxus*, No. 28270, ♂. Figures natural size.

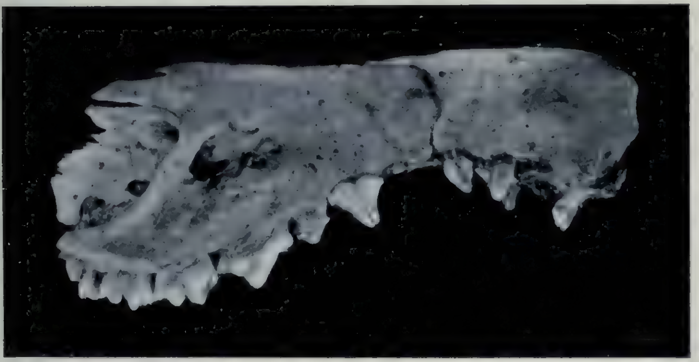
1



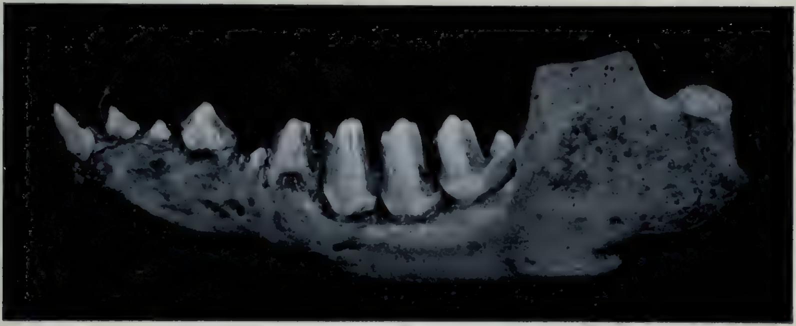
2



3

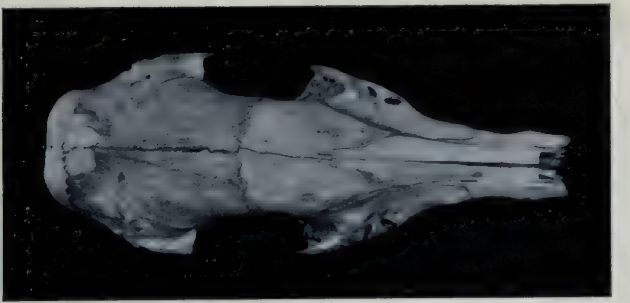


4

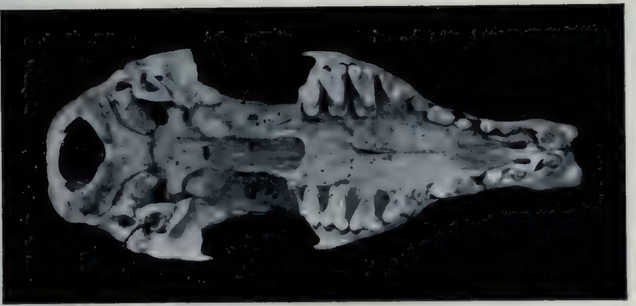


SOLENODON. *Milk Dentition.*
Figures twice natural size.
S. paradoxus. No. 28272.

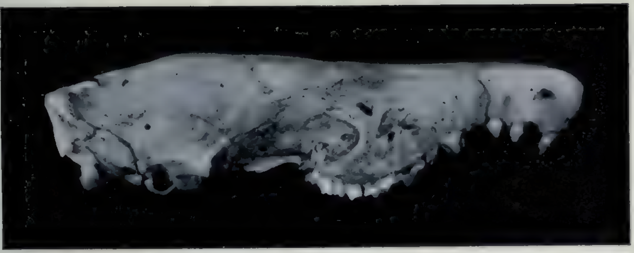
1



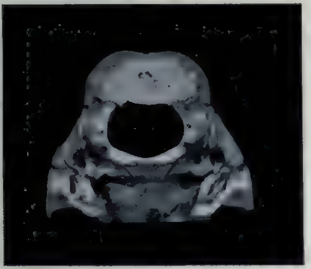
2



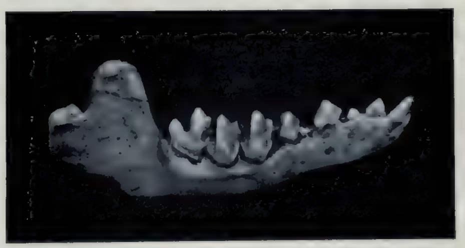
3



4



5



SOLENODON.

Figures natural size.

S. paradoxus. Young skull, showing sutures. Fig. 4, slightly oblique view of occipital aspect.

56.57, 98L

Article XXIV.— A FOSSIL LARRID WASP.

By S. A. Rohwer.

There are but two fossil Larridæ known. One, *Larrophanes ophthalmicus* Handl. from Gabbro, Italy, and the present new one. The following is the original description of *Larrophanes ophthalmicus* (p. 888, VI, Fossilen Inseckten): "In der Sammlung v. Bosniaski befindet sich ein merkwürdiges Hymenopteron, welches ich nur bei den Sphegiden unterbringen kann. Der Abdruck ist leider etwas undeutlich und lässt das Flügelgeäder nicht unterscheiden. Die Flügel waren relativ kurz, der Körper sehr schlank, 22 mm. lang und von dem Habitus einer sehr schlanken Larride oder Pompilide, mit ziemlich kurzen Beinen. Das Abdomen war kurz gestielt und hinten spitz zulaufend. Auffallend sind die grossen in der Mitte zusammenstossenden Facettaugen, welche etwa an jene der Astatus-Männchen erinnern. Jedenfalls gehört diese Form in die Gruppe der Larrinen, bei welcher ähnliche Augen mehrfach vorkommen, ist aber mit keiner der bekannten Gattungen zu identifizieren."

Pison cockerellæ sp. nov.

♀. Length about 11 mm., length of anterior wing 7½ mm., width of thorax 3½ mm., width of head 3½ mm. Head as wide as thorax, finely and evenly punctate; antennæ inserted low down on face; ocelli in an equilateral triangle; eyes apparently but slightly emarginate within, however this is not clear in the fossil; dorsulum and scutellum finely, evenly punctate, similar to head; metathorax strongly obliquely striated, middle furrow not strong but quite distinct; on the posterior face the striæ start from the middle furrow; first cubital cell long, longer than the second and third combined; receiving the first recurrent nervure near the apex; second cubital cell petiolate, the petiole shorter than the width of the cell; third cubital cell much narrower on the radial nervure than on the cubital nervure, receiving the second recurrent nervure near its base; submedian cell shorter than the median, about as in *Parapison* (Fig. 3, p. 459, Die Gattungen der Sphegiden, Kohl); abdomen impunctate. Color black; wings subhyaline, venation brown.

The following measurements are in μ:

First recurrent nervure basad to first transverse cubitus	119.
Length of the petiole of second cubital cell	187.
Third transverse cubitus beyond second transverse cubitus on radius . . .	85.
Second recurrent nervure beyond second transverse cubitus	170.
Transverse median basad to basal nervure	136.

Habitat — Station 14, Florissant, Colorado, 1907 (W. P. Cockerell).

In shape of the third cubital cell and position of the transverse median this species is more like a *Parapison* (= *Pison* ff. Kohl) than *Pison*, but the second transverse cubitus in *Parapison* is wanting. This genus (*Pison*) has more species in the Australian Region than any other region. It has one species in the Nearctic Region, and is represented by twelve in the Neotropical Region.

Type in the American Museum of Natural History.

SUPPLEMENTARY NOTE.

BY T. D. A. COCKERELL.

From the amber Museum at Königsberg, Prussia, I have received for study a Larrid found in Prussian Amber, of oligocene age. This is much older than the species described above, but does not show any especially primitive characters.

Pison oligocenum sp. nov.

♀. Black or very dark brown, length 8 mm. or a little less; head broad (about 2 mm.), length of anterior wings about 4 mm., nervures dark. Stigma very slender, little developed; marginal cell long, narrow, sharply pointed, ending on costa; three submarginal cells, the first much longer than the other two combined; second s. m. petiolate above, a subequilateral triangle, about 272 μ across; third s. m., measured obliquely, 493 μ long, but only 170 μ on marginal; first recurrent nervures meeting first transversocubital, second joining third s. m. 51 μ from base; basal nervure falling about 100 μ short of transverso-medial. Length of third antennal joint 246 μ. A further account of *P. oligocenum* will be given in my general report on the amber wasps and bees, to be published in Germany.

56.57, 93T(78.8)

Article XXV.— ON THE TENTHREDINOIDEA OF THE FLORISSANT SHALES.

By S. A. Rohwer.

Through the kindness of Prof. T. D. A. Cockerell I have had the pleasure of working up the fossil Tenthredinoidea of the expedition of 1907 to the Florissant shales. In working the species of this expedition a few notes on some already described species were made and as they may be useful they are given in the following paper. To make easier the determination of new material a table to separate all the species known to occur at Florissant is given.

At present there are eighteen genera represented in the Tertiary at Florissant, seven of which are known only in the fossil condition. Comparing the fossil and recent species we find that there are 25 fossil species to 31 recent species (these represent 14 genera). Two of the genera are known to be both recent and fossil. Six of the fossil genera are not known to occur in Colorado to-day but are found in the eastern or southern parts of the United States. Of the five remaining genera that are found both fossil and recent in Colorado all but *Tenthredo* and *Pteronus*, which are circumpolar, may be called eastern genera, having more eastern than western species. It will be seen from the above that the fossil fauna of Florissant bears but little resemblance to the recent fauna, but is more like the present day fauna of the eastern States, Virginia and northward.

I wish to express my thanks to Mr. C. T. Brues for the kindness of sending his manuscript before his valuable paper (Bull. Mus. Comp. Zoöl., Vol. LI, No. 10) appeared, and to Prof. T. D. A. Cockerell for valuable assistance.

The types of the new species herein described, except *Pseudocimbex clavatus*, are in the American Museum of Natural History.

Table to Separate Tenthredinoidea of Florissant Beds.

	Radial cell *with two* cross-nervures; length perhaps 13 mm.	*Megaxyela petrefacta* Brues.
	Radial cell *with one* cross-nervure	1.
	Radial cell *without* a cross-nervure	18.
1.	Front wings with a subcostal nervure	2.
	Front wings without subcostal nervure	3.
2.	Cu_2 present; abdomen dark; smaller	*Atocus defessus* Scudd.
	Cu_2 absent, abdomen light; larger	*Neurotoma cockerelli* Roh.

3. Lanceolate cell of fore wings petiolate . . . . 4.
Lanceolate cell of fore wings not petiolate . . . . 6.
4. Second and third cubitals receiving a recurrent nervure; basal and first recurrent not parallel; length 4 mm. . . . . . *Fenusa primula* Roh.
Second cubital receiving both recurrent nervures; basal and first recurrent parallel; length 7 mm. or more . . . . 5.
5. Transverse median received in about middle of first discoidal cell; second recurrent almost interstitial with second transverse cubitus. *Dineura laminarum* Brues.[1]
Transverse median received before the middle of first discoidal; second recurrent not nearly interstitial with second transverse cubitus. *Dineura saxorum* Ckll.[1]
6. Basal nervure and first recurrent nervure not parallel . . . . 7.
Basal nervure and first recurrent nervure parallel . . . . 8.
7. Lanceolate cell contracted; basal nervure joining subcostal remote from origin of cubitus . . . . *Hemichroa eophila* Ckll.
Lanceolate cell with an oblique cross-nervure; basal nervure joining the cubitus near its base . . . . *Paremphytus ostentus* Brues.
8. Lanceolate cell with an oblique cross-nervure; basal nervure joining subcosta at or near the origin of cubitus . . . . 9.
Lanceolate cell with a straight cross-nervure or contracted; basal nervure joining subcosta remote from origin of cubitus . . . . 14.
9. Basal nervure interstitial or nearly so with transverse median . . . . 10.
Basal nervure remote from the transverse median . . . . 11.
10. Abdomen unicolorous; stigma bulging from costa, transverse radial very close to apex . . . . *Paleotaxonus typicus* Brues.
Abdomen pale, marked with black; stigma not bulging from costa, transverse radial near middle and drawing stigma out *Paleotaxonus trivittatus* Roh.
11. Length 17 mm. . . . . 12.
Length 9 mm. . . . . 13.
12. Transverse median somewhat more than its own length beyond basal nervure . . . . *Pseudosiobla misera* Brues.
Transverse median less than its own length beyond basal nervure *Pseudosiobla megoura* Ckll.
13. Second cubital on radial more than two times as long as first cubital on cubitus; wings infuscated . . . . . . *Eriocampa scudderi* Brues.
Second cubital on radial no longer than first cubital on cubitus; wings hyaline . . . . *Eriocampa wheeleri* Ckll.
14. Lanceolate contracted . . . . 15.
Lanceolate cell with a straight cross nervure . . . . 16.
15. Three enclosed cubital cells; antennæ not clavate, 9-jointed *Macrophya pervetusta* Brues.

---

[1] Since the above was written another species of *Dineura* was found. The three may be separated as follows:
Transverse median received by first discoidal between middle and base; (length 7 mm., head and thorax dark, abdomen banded with light) . . . . . *D. saxorum* Ckll.
Transverse median received by first discoidal near middle, not a noticeable distance basad to middle . . . . 1.
1. Robust; intercostal vein not its own length basad to basal; second recurrent very close to second transverse cubitus . . . . *D. laminarum* Brues.
Slender; intercostal vein more than its own length basad to basal; second recurrent quite free from second transverse cubitus . . . . *D. cockerelli* Roh.

Two enclosed cubital cells; antennæ clavate, 6-jointed. *Trichiosomites obliviosus* Brues.
16. Lanceolate cell of hind wings not petiolate at apex . . *Tenthredo avia* Brues.
Lanceolate cell of hind wings petiole at apex . . . . 17.
17. Length 13 mm.; venation light; petiole of lanceolate cell of hind wings short, less than one third of basal nervure . . *Tenthredo submersa* Ckll.
Length 10½ mm.; venation dark; petiole of lanceolate cell of hind wings more than half the length of basal nervure . . *Tenthredo infossa* Brues.
18. One enclosed cubital cell; ovipositor long, projecting much beyond end of the abdomen . . . . *Lithoryssus parvus* Brues.
Two or more enclosed cubital cells; ovipositor not projecting . . . . 19.
19. Second cubital receiving both recurrent nervures; lanceolate cell petiolate; length seven mm. . . . . *Pteronus prodigus* Brues.
Second cubital receiving only one recurrent nervure . . . . 20.
20. Lanceolate cell petiolate; length 9 mm. . . . *Lisconeura vexabilis* Brues.
Lanceolate cell with a cross nervure, not petiolate; length 17 mm. or over; antennæ clavate . . . . 21.
21. Length 17½ mm.; apical joint of antennæ truncate *Pseudocimbex clavatus* Roh.
Length 25 mm.; apical jointed of antennæ rounded at apex *Phenacoperga coloradensis* Ckll.

LYDIDÆ.

Neurotoma *Konow.*

Neurotoma cockerelli sp. nov.

Apparently a male. Length 11 mm. Head nearly as wide as thorax; broadest across the orbits; hind margin rounded; narrowest at base of mandibles, antennæ inserted close to clypeus; basal joint longer and broader than second (from the second the joints are wanting). Head and thorax deeply and coarsely punctured; basal plates finely punctured; abdomen smooth. Color black; abdomen beyond the basal plates ferruginous with darker bands at the junction of the segments. Wings hyaline; nervures brown, stigma paler.

Comparing the venation with that of *Neurotoma fasciata* (fig. 36, plate xxiv Proc. U. S. Nat. Mus., Vol. xxix) the following differences were noted:

(1). The basal nervure joins the cubitus nearer the middle of the first cubital cell, and is slightly more oblique.
(2). The transverse median joins the anal nervure nearer the cross nervure of the lanceolate cell.
(3). The third cubital cell is longer.
(4). The second recurrent nervure is longer and is straight.

Habitat.— Station 17, Florissant, Colo., 1907 (T. D. A. Cockerell).

The only other member of this family known from the Florissant shales is *Atocus elefessus* Scudder. *Neurotoma cockerelli* may be easily known from this species by the absence of the cross nervure between the median cell and the second anal cell (Cu_2 being absent); the light-colored abdomen; and its larger size.

Atocus *Scudder.*

This genus is known only by the type species. It falls between *Neurotoma* Knw. and *Pamphilius* Latr. It may be separated from *Neurotoma* by the presence of Cu$_2$, and from *Pamphilius* by the absence of Sc$_1$. I am indebted to Prof. T. D. A. Cockerell for his notes on Mr. Scudder's type of *Atocus defessus.* Mr. C. T. Brues (p. 270, Bul. Mus. of Comp. Zoöl. 1908) gives some valuable notes on this genus.

TENTHREDINIDÆ.

EMPHYTINÆ.

Paleotaxonus *Brues.*

This genus will fall near *Pseudosiobla* Ashm., both having the transverse median and basal nervure interstitial or nearly so. It may be separated from *Pseudosiobla* by the following comparison:

Paleotaxonus Brues.	*Pseudosiobla* Ashm.
1. Intercostal vein present.	1. Intercostal vein absent.
2. Subdiscoidal nervure (m$_3$) parallel with the cubitus.	2. Subdiscoidal nervure (m$_3$) not parallel with the cubitus.
3. Marginal cell made angulate by the drawing down of the marginal nervure by the second transverse cubitus.	3. Marginal cell not thus angulate, rounded on the lower margin.
4. Second cubital cell much more than half the length of the third cubital cell.	4. Second cubital cell but a little more than half the length of third cubital cell.

Paleotaxonus typicus Brues and *Pseudosiobla excavata* Nort. differ in the shape of the stigma, but *Paleotaxonus trivittatus* Roh. has the stigma similar to *Pseudosiobla excavata,* and it is undoubtedly a *Paleotaxonus.*

In the costal area *Paleotaxonus* is similar to *Stromboceros* Konow, but is quite distinct from that genus, being known at once by the presence of a cross nervure in the lanceolate cell.

Paleotaxonus trivittatus sp. nov.

Probably a female. Length 10 mm., length of anterior wing 7½ mm.; width of abdomen in widest part 3 mm. Head as usual in the larger species of *Taxonus;* malar space not large, although perhaps it is not wanting; antennæ not reaching beyond the metanotum. Intercostal vein very distinct, a little less than its length basal of basal vein; basal vein joining the subcostal about twice the length of the intercostal vein basal to the origin of the cubitus; second cubital cell wider where the first recurrent nervure joins it than at any other place; third cubital cell about three times wider at apex than at base; transverse medial received a little beyond the middle of third cubital cell; subdiscoidal nervure (m_3) long, parallel with cubitus; third discoidal cell long and narrow as in *Paleotaxonus typicus*; stigma tapering from base to apex, more drawn out where the transverse marginal joins it than it is in *P. typicus*, not forming a bulge on the costa as *P. typicus*, similar to *Pseudosiobla excavata* Nort.; cross nervure of lanceolate cell a little more oblique than in *P. typicus* (according to Mr. Brues's figure of *P. typicus*). Hind wings with two discal cells, the upper exceeding lower on outer margin, but it is not as wide; lanceolate cell of hind wings with a distinct petiole at apex, which is about as long as in *Eriocampa*. Color rufous; middle lobe of mesonotum, basal plates, four posterior legs (the anterior ones cannot be seen) quadrate spots on sides and in middle of each abdominal segment above black; antennæ apparently rufous. Wings hyaline; nervures and stigma black.

Habitat.— Station 13, Forissant, Colo., 1907 (T. D. A. Cockerell).

The specimen is very well preserved. The markings of the abdomen are very distinctive. I know of no American species of Emphytinæ that is similarly marked. In the presence of the intercostal nervure this differs from *P. typicus.* This may make some difference in its generic position, but if so *Paleotoxonus* would verge into *Pseudosiobla.*

Pseudosiobla *Ashmead.*

Pseudosiobla megoura *Ckll.*

I do not think that this is a true *Pseudosiobla,* but it is nearest to this genus and for the present will be left here. The transverse marginal is not so bent as in *Pseudosiobla excavata* (Fig. 48, plate xxviii, Vol. xxix, Proc. U. S. Nat. Mus.); the basal nervure is farther from the cubitus; the transverse medial in basal fourth of first discoidal. The large, long abdomen and the habit of entire fossil are very unsuggestive of *Pseudosiobla.*

Tenthredo misera Brues is probably the same as this species. If this is true *misera* would be a synonym of *megoura.* Mr. Brues description of *misera* does very well for *megoura,* and *misera* is not a *Tenthredo,* the cross-nervure of the lanceolate cell being oblique. However these two species may be separated by the characters given in the foregoing table.

Eriocampa *Hartig.*

Eriocampa wheeleri *Ckll.*

A specimen from station 14, 1907 (Geo. N. Rohwer) seems to be the female of *wheeleri.* The venation measurements average about 110 μ larger than those given by Prof. Cockerell, but there is no difference otherwise. Length 9 mm.

PHYLLOTOMINÆ.

Paremphytus *Brues.*

This is a very remarkable genus! It is easily separated from its allies (*Caliroa* Costa, *Eriocampoides* Knw., *Phyllotoma* Fallen) by the loss of the first transverse cubital; basal nervure joining cubitus; shape of first and third discoidal cells; etc.

NEMATINÆ.

Pteronus prodigus *Brues* ♀. Station 14 (W. P. Cockerell) — 1907. Length 8 mm.; legs apparently black.

CIMBICINÆ.

Trichiosomites *Brues.*

An excellently preserved specimen with reverse from station 14, 1907 (W. P. Cockerell) differs in these points from Mr. Brues' description of *T. obliviosus:* — Abdomen rufous; venation pale brown; basal nervure curves gently inward; third transverse cubitus (the first is absent) a little longer, thus causing the marginal and cubital nervures to diverge more strongly; scutellum not smooth, but punctured as the rest of thorax with deep well separated punctures. His specimen may have been a male, this is undoubtedly a female.

PHENACOPERGINÆ.

Pseudocimbex gen. nov.

Body similar to Cimbex. Head a little wider behind eyes; antennæ apparently 7-jointed, clavate, the last two joints forming the club, the last joint truncate at apex; the club is very broad and short having a spherical appearance; radial cell without an appendiculation; a distinct subcostal cell; intercostal vein wanting; basal nervure and transverse median interstitial; stigma very narrow; two enclosed cubital cells (the fossil where the first transverse cubitus should be is rather faint, but I feel sure this is as described); first and second cubitals each receiving a recurrent nervure; basal nervure and first recurrent parallel or subparallel; lanceolate cell of fore wings short, ending a short distance before the transverse median, a slightly oblique cross-nervure in about middle of cell (the anal area is somewhat obscure, but I believe it is as here described).

Type of genus *Pseudocimbex clavatus* Roh.

Following Rev. Konow's arrangement (genera Insectorum, 1905) this genus and *Phenacoperga* Ckll. would form a new tribe between the Cimbicini and Syzygonini. Following Dr. A. D. MacGillivray (Proc. U. S. Nat. Mus., Vol. XXIX, pp. 569–654, 1906) this new subfamily falls nearer Nematinæ than it does Perginæ. In general habit it resembles Cimbicinæ and Perginæ (including all allies), but I think it is nearer the Cimbicinæ. I have followed Dr. MacGillivray and called it a subfamily.

The two genera of this new subfamily are both fossil. They may be separated as follows:

Phenacoperga Ckll.	*Pseudocimbex* Roh.
1. Club of antennæ obtusely rounded at apex, elongate.	1. Club of antennæ truncate at apex, short, somewhat spherical.
2. Radial cell angulate near base, caused by the pulling down of the second transverse cubital.	2. Radial cell not thus angulate, rounded on lower margin.
3. Lanceolate cell long and rather narrow, not ending before the transverse median.	3. Lanceolate short and broad, ending before the transverse median.
4. Cross-nervure of lanceolate cell near base of cell.	4. Cross-nervure of lanceolate cell in about the middle.

Phenacoperga coloradensis and *Pseudocimbex clavatus* may be known from each other most easily by their size. *P. coloradensis* is 25 mm. long, while *P. clavatus* is only 17½ mm.[1]

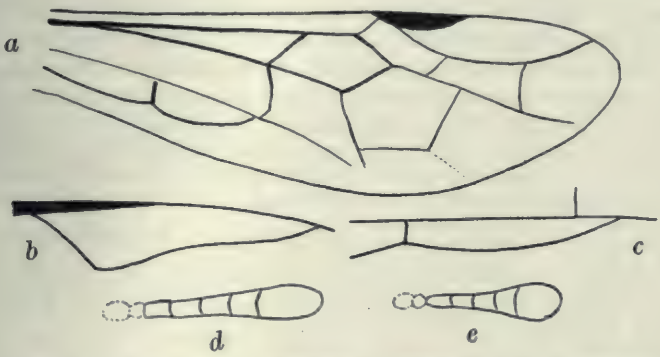


Fig. 1, *a*, Fore wing of *Pseudocimbex clavatus* sp. nov.; *b*, radial cell of *Phenacoperga coloradensis* Ckll.; *c*, lanceolate cell of same; *d*, antenna of same; *e*, antenna of *Pseudocimbex*.

---

[1] In the figure the stigma of *P. clavatus* is too large, the lanceolate cell of *P. coloradensis* too wide and the cross-nervure straight instead of oblique.

Pseudocimbex clavatus sp. nov.

Apparently a ♀. Length 17½ mm.; length of fore wing 14 mm. Head not quite as wide as thorax; antennæ short, stout, very thick, the last two joints forming the club which is very broad appearing spherical; first recurrent nervure received in about middle of the first cubital cell; second recurrent received in about the middle of second cubital cell; subcostal cell similar to *Lophyrus* sp. (fig. 45, Proc. U. S. Nat. Mus., Vol. XXIX, plate xxvii), but is not as broad above the basal nervure; stigma very narrow almost wanting; cross-nervure of lanceolate cell rather broad and slightly oblique, color black; abdomen probably rufous. Wings apparently fuscous; nervures and stigma dark brown.

Habitat.— Florissant, Colo. Collector unknown. Probably from Fossil Stump Hill at station 17.

Type in the museum at the State Capitol Building, Denver, Colorado.

FENUSINÆ.

Fenusa *Leach.*

Fenusa primula sp. nov.

Probably a ♀. Length 4 mm.; length of fore wing 3½ mm. Head not as wide as thorax, antennæ as usual; costa thick also subcosta; stigma rounded on lower margin; basal nervure very strongly bent, cubitus on the lower part of first cubital cell very weak; first cubital cell much narrower at apex than at base, in this respect like *Scolioneura betuleti* (fig. 75, Proc. U. S. Nat. Mus., Vol. xxix, plate xxxvii); second cubital three times wider at apex than at base; first recurrent received in first cubital a little beyond middle; second recurrent at about basal third of second cubital; transverse radial in about middle of second cubital; transverse median received a little beyond middle of first discoidal; lanceolate cell petiolate, the upper part of the petiole very weak, petiole probably longer than *Fenusa pygmæa* (Fig. 74, Proc. U. S. Nat. Mus., Vol. xxix); hind wings not decipherable, but the lanceolate cell seems to be reduced to a line as in *Kaliosysphinga dohrnii* (fig. 73, Proc. etc.). Color black; wings subhyaline, nervures brown.

Differs from *Fenusa pygmæa* (fig. 74, Proc. etc.) in the following characters: (1) first transverse (really second because the first is wanting) cubitus is shorter; (2) stigma rounded on lower margin, not angulate; (3) transverse radial slightly curved; (4) upper nervure of lanceolate cell weak; (5) first recurrent a little nearer transverse cubitus; (6) second transverse cubitus is not so oblique; (7) cubitus arising nearer basal.

The following measurements are in μ:

(1).	Length of first (second) transverse cubitus	85
(2).	Width of second cubital at third transverse cubitus	289
(3).	Width of stigma in widest part	238
(4).	Distance from lower (nearest) part of stigma to second transverse cubitus	238
(5).	Width of median cell (widest part)	187

Habitat.— Florissant, Colo., station 14, 1907 (S. A. Rohwer.).

SCHIZOCERINÆ.

Lisconeura gen. nov.

Broad, stout species; abdomen somewhat oval; intercostal vein absent; stigma rounded on lower margin; basal nervure more than half its own length basal to origin to cubitus; first recurrent short, not parallel with basal; three enclosed cubital cells, the first small, the second and third of about equal length; second and third cubitals each receiving a recurrent nervure; transverse median near middle of first discoidal cell; lanceolate cell petiolate; antennæ question.

Type, *Scolioneura vexabilis* Brues, Bull. Mus. of Comp. Zoöl., Vol. LI, No. 10, p. 263. March, 1908.

This genus may not belong in this subfamily, but the venation is nearer to this group than any other. If the antennæ are more than three jointed there would be no doubt that it would form a new subfamily. Mr. Brues assigned this to *Scolioneura* with a doubt, but it is not very closely related to that genus. The position of the basal nervure alone would exclude it from that genus. The shape of the second and third cubitals will easily separate it from its supposed allies.

DINEURINÆ.

Dineura *Dahlb.*

There have been two species described as belonging to this genus and there is another in this collection. The three species so far known may be separated by the characters in the foregoing table. There are other characters which also separate them. *D. laminarum* has the intercostal nervure quite close to the basal, not its own length basad to basal; *D. cockerelli* has it about one and a half times its length basad to basal; *D. saxorum* has it two times its length basad to basal. In the position of the intercostal nervure and second recurrent nervure *cockerelli* is nearer to *saxorum* but easily known by the position of the transverse median. All the fossil species differ from *Dineura* as now defined in the position of the intercostal nervure. *D. cockerelli* and *saxorum* have it as in *Mesoneura* Hartig, but position of the transverse radial, second recurrent, and the shape of the costa are not as in that genus. *D. laminarum* has the intercostal as in *Pseudodineura* Knw., but in the character of the transverse radial and second recurrent it is more like *Mesoneura. Dineura* Dahlb., *Mesoneura* Hartig, and *Pseudodineura* Knw. are closely related and undoubtedly had a near common ancestor or *Mesoneura* and *Pseudodineura* have been recent offshoots from *Dineura*.

Dineura laminarum *Brues.* A well perserved specimen from Station 14, 1907 (W. P. Cockerell) differs from the description of the type in having the second recurrent a considerable distance from the second transverse cubitus, about as in *D. geeri* (fig. 63, plate xxxiii, Proc. etc); and the thorax is entirely black. The following measurement of this specimen may be of value.

Length of intercostal nervure 119 μ.
Intercostal basad to basal nervure 85 μ.
First recurrent from first transverse cubitus 663 μ.
Length of first cubital cell on cubitus 527 μ.

Dineura cockerelli sp. nov.

Probably a ♂. Length 8½ mm.; length of anterior wing about 7½ mm. Rather slender, not nearly so robust as *D. laminarum*. Head partly covered with a piece of wood. Stigma widest at base tapering gently to apex; intercostal vein about one and a half times its length basad to basal; basal nervure curved on the lower part; transverse radial not strongly oblique, received a little beyond second transverse cubitus as in *D. geeri* (fig. 63, plate xxxiii, Proc. etc.); transverse median received a little beyond middle of first discoidal cell; first recurrent nervure received in second cubital cell nearly the length of first cubital from base; second recurrent received in second cubital about the length of second transverse cubitus from apex; third discoidal sharply pointed at apex, caused by the inward move of the second recurrent; lanceolate cell as in *D. geeri*. Hind wings as usual, except the lower discal cell is shorter than the upper, about as in *Pseudodineura hepaticæ* (fig. 65, plate xxxiv, Proc. etc.), *D. saxorum* and *D. laminarum* also have this character. Color: head and thorax dark; legs as much as could be seen dark; abdomen dark banded with light as in *D. saxorum*. Wings hyaline; nervures and stigma dark brown.

The following differences were noted when compared with *Dineura geeri* (Fig. 63, Proc. etc.):

(1). Intercostal nervure considerably basad of basal.
(2). Stigma more tapering.
(3). Third discoidal cell more sharply pointed at apex.
(4). First recurrent nearer middle of second cubital cell.
(5). Second “ “ “ “ “ “ “
(6). Lower discal cell of hind wings shorter than upper.

The following measurements are in μ.

Length of intercostal nervure	85
Intercostal nervure basad to basal	154
Transverse median from basal	833
First recurrent from first transverse cubitus	425
Length of first cubital cell on cubitus	476

Habitat.— Florissant, Colo., station 13 B[1] (S. A. Rohwer), 1907.

---

[1] *Station 13B* is between Stations 13 and 14, lower on the slope than 13 (see Ckll. Vol. XXIII, 1907, p. 131, Bull. Am. Mus. Nat. Hist.). Geographically it is lower than either 13 or 14, but the layer worked at 13B is the same as that worked at 14. While the layers worked at 13 correspond to 14A (the upper layer of 14 above the heavy sandstone and shale, about 8 feet above) but are much more weathered and break with ease. During the expedition of 1907 station 14 was extended eastward to meet the excavations made years ago at station 9. However the central part of 9, where all 1906 and 1907 fossils came from, was not reached.

56.79,5L(115)

Article XXVI.—NOTES ON THE SKULL OF *LYSOROPHUS TRICARINATUS* COPE.

By E. C. Case.

The genus *Lysorophus* was first described by Cope from several vertebræ from the bone bed of eastern Illinois (Cope, '77). Later Case gave a more detailed account of the vertebral column (Case, '00 and '02). Finally Broili, from very full material, supplemented the description of the vertebræ and gave an account of the skull. He came to the conclusion that *Lysorophus* was entirely limbless and a member of an extremely primitive family of reptiles to which he gave the name Paterosauridæ (Broili, '04 and '04). This family he regarded as one of the original groups of reptiles, assigning to the reptiles a diphyletic origin. He says ('04): "Wir müssen also für die Reptilien eine diphyletische Entwicklung annehmen, deren eine Wurzel bei den amphibischen Stegocephalen zu finden, deren andere, aller Wahrscheinlichkeit nach, bei den Fischen zu suchen ist."

A series of five skulls in the collection of the American Museum, collected by the author in Texas in the summer of 1906, permits some addition to Broili's description of the skull. In one the palate is exposed and a careful preparation has revealed something of the interorbital structure. The bones of the upper surface show a practical agreement with the description given by Broili. The bone described by him as the postfrontal extends forward to the nostril and forms a portion of its border, it having the position usually occupied in the reptiles by the postfrontal, prefrontal and the lachrymal. The posterior angles of the skull and the region of the nostrils are wider than figured by Broili, but these may well be specific differences (Fig. 1, *C*).

The palate is distinctly amphibian. The posterior surface is formed by a large flat bone, undoubtedly a parasphenoid; in two specimens which show this bone there is a line dividing it into anterior and posterior portions, but it is impossible to say whether this is a simple break or a break following the line of a suture. In one specimen the posterior portion is directly continued into the occipital region forming a portion of the articulation; it is impossible to tell whether this occipital portion is a separate element or is continuous with the large plate. I take the large plate to be the parasphenoid plus the basisphenoid, with the basioccipital cartilaginous. It seems certain that Broili's assumption, that there was a basioccipital with a single, reptilian condyle and that it has been lost, is wrong. The articulation of the skull to the vertebral column was by two exoccipital (?) condyles.

Anterior to the parasphenoid it is impossible to determine the separate elements. There are two nearly concentric rows of sharp, even teeth. The maxillary-premaxillary series is nearly semicircular and extends back nearly as far as the anterior end of the parasphenoid. The inner, vomerine series is shorter but has nearly the same form as the outer. Between the inner rows of teeth and the plates which support them there is a deep vacuity extending to the upper surface of the skull; this region was excavated with the greatest care and not the slightest trace of any roof to this portion of the mouth was encountered. It probably represents the large posterior openings of the nares (Fig. 1, *D*).

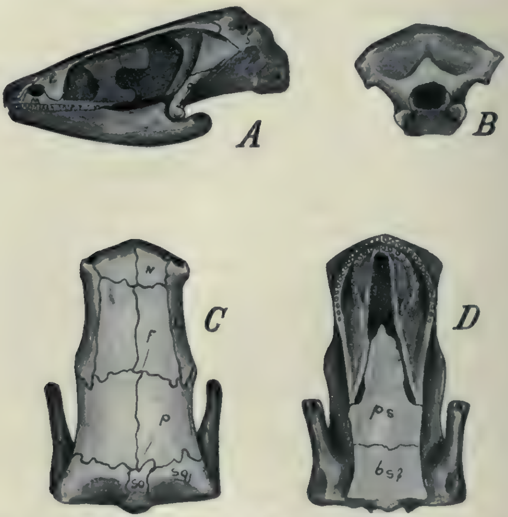


Fig. 1. *Lysorophus tricarinatus* Cope. Figures × 2. *A*, lateral view of skull; *B*, posterior view of skull; *C*, upper view of skull; *D*, palatal view of skull.

The lateral view of the skull shows the large orbital cavity. Broili considers that this must have been divided by a slender bar into temporal and orbital cavities, but in several perfect specimens of this region I find no trace of such a bar. The interorbital septum is composed, in the specimen, of three pieces but these may be fractured portions of an originally solid plate. In the posterior portion of the cavity a vertical plate appears just beneath the anterior edge of the quadrate; this may be the epipterygoid or the anterior edge of the brain case, more probably the latter (Fig. 1, *A*).

The articulation with the vertebral column was by two condyles formed by distinct, exoccipital elements (Fig. 1, *B*). In two specimens there are paired pre-atlantal elements between the skull and the first vertebra.

The evidence furnished by the palate emphasizes the extremely primitive character, as determined by Broili. The complete ossification of the vertebræ, the intra-vertebral position of the ribs (some of which are distinctly two-headed), and the well developed quadrate speak for the reptilian character of the animal; but the presence of the parasphenoid and the double articular condyles seem to render its amphibian nature unquestionable. Were it not for the extreme specialization of this limbless, Gymnophiona-like form it would occupy almost exactly the transitional position between the amphibians and reptiles. This evidence of its amphibian nature negatives the conclusion of Broili, drawn from the presence of jugular plates, that the reptiles may have had a diphyletic origin and have sprung from the fish as well as from the amphibians.

1877. **Cope, E. D.** Descriptions of the Extinct Vertebrata from the Permian and Triassic formations of the United States. *Proc. Am. Phil. Soc.*, Vol. XVII, pp. 182–193.

1900. **Case, E. C.** The Vertebrates from the bone bed of Vermillion County, *Ill. Journ. Geol.*, Vol. VII, p. 698.

1902. **Case, E. C.** Paleontological Notes. *Journ. Geol.*, Vol. X, No. 3, p. 256.

1904. **Broili, Ferd.** Permische Stegocephalen u. Reptilien aus Texas. *Paleontographica*, Bd. L, p. 1.

1904. **Broili, Ferd.** Stammreptilien. *Anat. Anzeiger*, Bd. XXV, p. 579.

56.9,735 B (1182: 7)

Article XXVII.— OSTEOLOGY OF *BLASTOMERYX* AND PHYLOGENY OF THE AMERICAN CERVIDÆ.

By W. D. Matthew.

In a preliminary contribution upon the Lower Miocene fauna recently discovered in South Dakota (Matthew, 1907), the writer commented upon its importance in supplying the intermediate stages between hitherto disconnected faunæ, and in enabling us to perceive the exact relationships between genera which could until now be connected only in a general or provisional way. One of the most interesting and important of these connecting links is furnished by the complete knowledge of the osteology of *Blastomeryx.* This genus proves to be a very primitive deer, approximately ancestral to the American Cervidæ, and derivable in its turn from the Oligocene genus *Leptomeryx,* whose relationship to the Cervid phylum had not been suspected. We are thus enabled to trace the ancestry of the American Cervidæ back to the Oligocene, by successive stages known from the entire skeleton, and not merely from the inadequate evidence of teeth and jaws. This phylum is thus placed on a plane with those of the Equidæ, Camelidæ and a few other series. It is indeed an approximate phylum: the known species are probably not in direct genetic sequence. But this reservation applies, in my opinion, to all the accepted phyletic series to a greater or less extent. It is a necessary consequence of the general causal conditions of the evolution of the Tertiary mammals.

The evidence for the establishment of this phylogeny can conveniently be presented in the following sequence:

1. A somewhat detailed account of the osteology of *Blastomeryx,* based upon the Lower Miocene species.
2. Specific distinctions and geological occurrence of *Blastomeryx.*
3. Relationship of *Blastomeryx* to the modern Cervidæ, and the evidence on which it is considered approximately ancestral to the American Telemetacarpal deer.
4. Trend of evolution in this phylum, indicating what we should expect to find in the Oligocene ancestors of *Blastomeryx.*
5. Relationship to European Oligocene Selenodonts.
6. Relationship to *Leptomeryx* of the American Oligocene; evidence of the Cervid affinities of this genus and for considering it as ancestral to *Blastomeryx.*
7. The phylogeny of the American Cervidæ and its interpretation.
8. Provisional phylogeny of American ruminants (diagram).
9. Classification of the Selenodonts (key).

1. *Osteology of Blastomeryx.*

The genus *Blastomeryx* has been hitherto very incompletely known. The discovery of several well preserved specimens in the Lower Miocene enables me to give the principal characters of the skeleton and to determine its relationship.

The principal specimens are:

No. 13822, a fairly complete skull and jaws with limbs and feet, and a few vertebræ.

No. 13015, anterior part of a skull with the greater part of the skeleton.

No. 13224, upper and lower jaws, hind limbs, and feet.

No. 13016, lower jaw, atlas and scapula.

No. 13014, lower jaw (type of *B. advena*).

Nos. 13017, 13823–4, etc., upper jaw, several incomplete lower jaws, hind foot, and various isolated bones.

All the above are from the Upper Rosebud beds on Pine Ridge Indian Reservation, South Dakota, excepting No. 13224, which is from Lower Miocene beds south of Lusk, Wyoming. They represent three specimens closely allied to each other and to the typical *B. gemmifer* from the Middle Miocene of Colorado.

Skull.— The general proportions of the skull are much as in *Moschus* or in *Dremotherium.* The face is rather short and deep anteriorly, the cranium comparatively long, with a low sagittal crest and moderately prominent occiput. The orbits are of medium size and not especially prominent, the anterior half of the orbit lies above m^3 and part of m^2. There is no trace of horns, the upper canines are developed into long, slender laniary tusks, as in *Moschus, Cervulus, Dremotherium,* etc. The superior branch of the premaxilla is a wide and rather long plate, as in *Moschus,* and much wider than in most of the modern deer. The nasals are long, slender, and narrow, entirely different in form from any modern Cervidæ; more as in *Tragulus,* and very like those of *Leptomeryx.* There was apparently a considerable prelachrymal fossa, but its exact proportions and limits, and the presence or absence of a facial vacuity cannot be determined. The basicranial region shows very primitive conditions, approaching those in *Leptomeryx.* The basioccipital and basisphenoid are long, narrow, and lie in nearly the same plane with the palate. The tympanic bulla is nearly round and strongly inflated, but small, and does not cover the entire mesotympanic fossa, leaving a depressed channel next to the basioccipital at the bottom of which appears the petrosal. The stylohyoid pit is comparatively small; the auditory meatus rather long, cylindrical, and but slightly

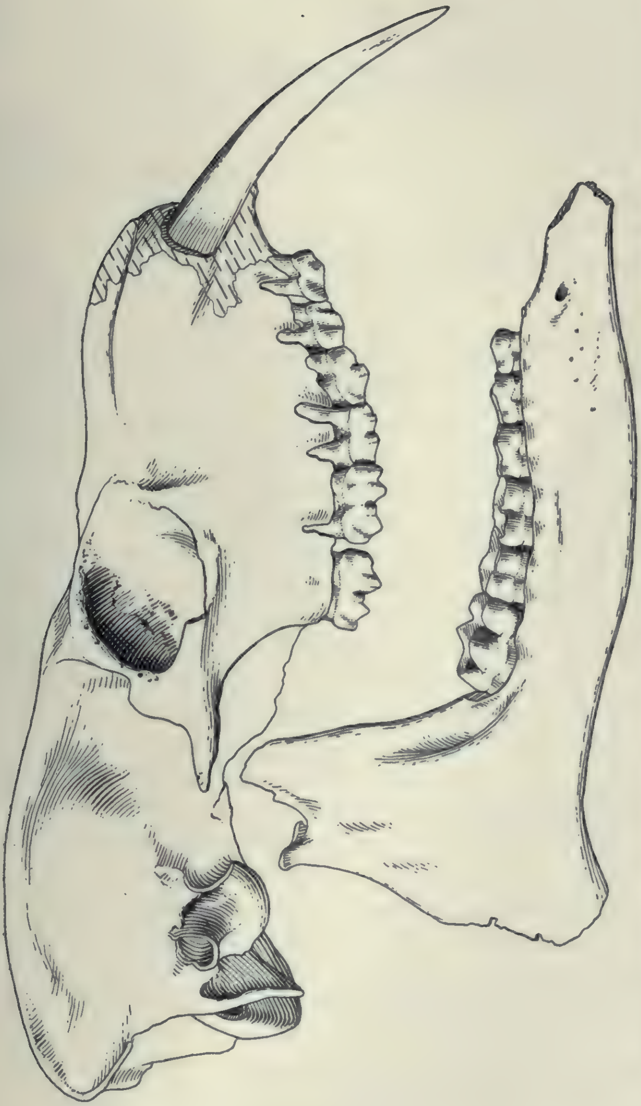


Fig. 1. *Blastomeryx primus*, Type, No. 13822. Side view of skull and lower jaw, natural size. The skull is somewhat crushed in the orbital region, and the upper canine displaced from its natural position.

flattened on its inferior surface. The various modern deer show different degrees of reduction and flattening of the bulla and meatus, with enlargement of the stylohyoid pit; in most of them the internal exposure of the inferior surface of the petrous bone is reduced, partly by widening of the basioccipital, partly by decrease of the petrous bone anterointernally. They also show a varying degree of shortening of the basicranium, elongation of the face, and increase of the angle between basifacial and basicranial axes.

The lower jaw is rather deep, comparatively short, and heavy anteriorly, with broad but short coronoid process and slenderly proportioned condyle as compared with most Cervidæ.

Dentition.— Formula $I\frac{0}{3}$ $C\frac{1}{1}$ $P\frac{3}{4-3}$ $M\frac{3}{3}$. The lower incisors and canines are small and procumbent. The upper canine is as large as in *Moschus*, projects downward, forward, and outward from the alveolus and vertically downward at the tip. The upper premolars are comparatively simple, constructed much as in *Dremotherium*, the second with apparently a small basal cusp representing the inner crescent, the third with an irregular and imperfect inner crescent formed by basal cingula extending from the inner cusp, and the inner cingulum complete only on the fourth premolar. The modern deer show various stages of advance beyond this, *Rangifer* being the most advanced, with the inner crescents fully formed and of identical type on all three premolars. The lower premolars show a correspondingly primitive stage. They are comparatively narrow, with the three internal crests not united internally but separated by open valleys. In the modern deer these inner crests join internally to a varying extent, enlosing basins or lakes. In the Bovinæ this premolar transformation is carried further, the lakes being usually more or less cement-filled.

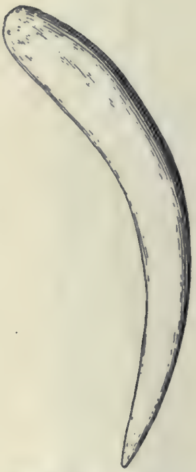


Fig. 2. *Blastomeryx olcotti*, Type, No. 13224. Upper canine, natural size.

The molars are moderately brachyodont, of rather uniform size, and uniform height of crown. The upper molars show the primitive Cervid pattern, strong parastyle, mesostyle and anterior external rib of the paracone, weak metastyle, and metacone flat externally. The upper molars have no internal cingulum but show a minute internal basal cuspule between the inner lobes; the corresponding external basal cusp between the outer lobes of the lower molars is more prominent. These Lower Miocene species of *Blastomeryx* show distinct traces of the "*Palæomeryx* fold" in the lower molars on the posterior face of the anterior inner crescent. The prominent anterior basal cingulum on the lower molars appears to be characteristic of the genus; it is more developed than in any other primitive deer with which I have made comparison.

In general the teeth correspond very nearly with those of *Dremotherium* and *Amphitragulus*.[1] The basal cuspules of the molars are stronger, the anterior basal cingula on m_{1-3} much more prominent. The premolars are very much the same in construction and proportions; they are intermediate between the simple trenchant type of the Tragulids and the double-crescent type of most modern Pecora. They are more advanced than the genera of the Phosphorites *Prodremotherium, Bachitherium, Lophiomeryx*,[2] less than *Dicrocerus* or *Palæomeryx*, decidedly less than the so-called *Palæomeryx* of the American Miocene.[3] In comparison with the American Oligocene genera *Leptomeryx* has essentially the same tooth pattern, but the premolars are simpler and more trenchant, their inner crescents very rudimentary, and the molars have shorter crowns and the crescents more obliquely set. In *Hypertragulus* the molar pattern is different, corresponding to that of *Tragulus*, and the premolars are, as also in that genus, much simpler and more trenchant, but more reduced than in the Chevrotain. In *Hypisodus* the molar pattern is also different, more like that of the Camelidæ; the teeth are much more hypsodont; the premolars are relatively small, compressed, and reduced, and the molars peculiarly narrow, as in the Camelidæ.

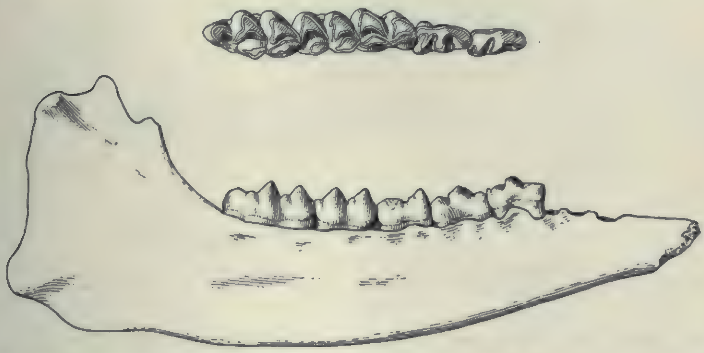


Fig. 3. *Blastomeryx olcotti*, Type, No. 13224. Lower jaw, inside view, and crown view of cheek teeth. Natural size.

Vertebræ.— The atlas resembles that of *Merycodus*, especially in the large size and incomplete separation of the cotyli and axis facets, and in the strongly marked paired median depressions at the anterior end of the arch for attachment of the occipital muscles. The fifth and sixth cervicals are moderately long, proportioned nearly as in *Mazama,* longer than in *Cervulus,* and much longer than in *Tragulus.* The dorsals, so far as they are preserved, are proportioned much as in the smaller deer and antelopes. The ribs are strongly curved, the anterior ones broad and flat, the posterior ones quadrate in cross-section proximally and flattened oval distally, the form throughout the series being much as in *Merycodus* and the smaller antelopes. In *Tragulus* the curvature and length of the ribs is much less, and their form more as in the smaller carnivora, narrow, little curved, round oval in section, and but little flattened or broadened in the anterior part of the series.

---

[1] See Filhol, 1881, pll. xiii–xvi.
[2] See Filhol, 1876–7.
[3] *Cf.* Matthew, 1904, fig. 21.

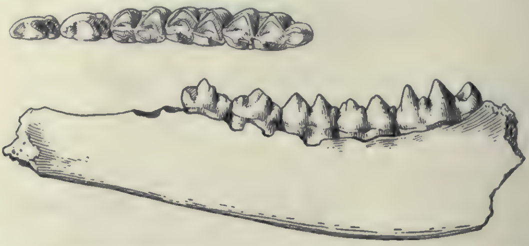


Fig. 4. *Blastomeryx advena,* Type, No. 13014. Lower jaw, inside view, and crown view of cheek teeth. Natural size.

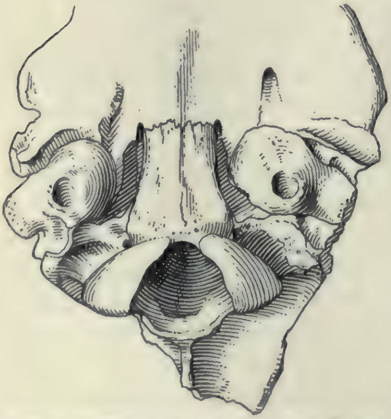


Fig. 5. *Blastomeryx primus,* Type, No. 13822. Basicranial region of skull, natural size.

There are six lumbars, all with short, broad plate-like spines which curve strongly forward in the posterior part of the series. The transverse processes are broad and flat, much shorter than in *Mazama,* somewhat shorter than in *Cervulus.*

The sacrum consists of four vertebræ, whose spines are coössified into a continuous plate, as in *Mazama* and most of the deer; not separate, as in *Cervulus.* In *Tragulus* the sacral spines are coössified into a continuous plate, but it is not so high, and differs in various details of form.

Two proximal caudals indicate a very short, small tail.

Fore Limb.— The scapula differs from that of the smaller Pecora chiefly in the prominence of the spine, which is higher than in *Merycodus,* much

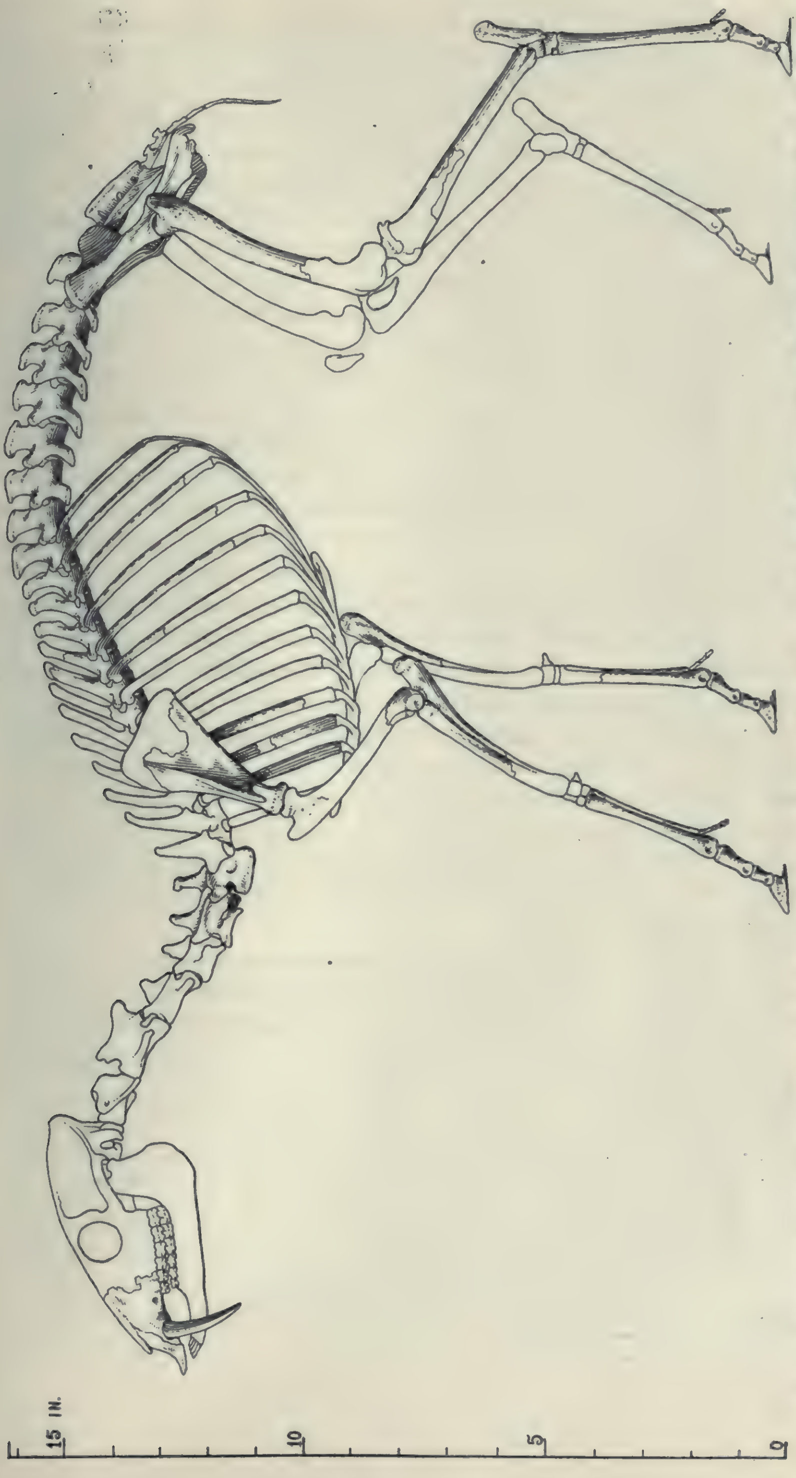


Fig. 6. *Blastomeryx advena.* Restoration of the skeleton, one-fourth natural size. No. 13015, Lower Miocene (Upper Rosebud beds) Pine Ridge, S. Dakota. The missing (unshaded) parts of head and limbs are restored from other specimens of *Blastomeryx* from the same horizon and locality, the missing vertebræ and ribs modified from *Cephalophus* and *Cervulus*.

higher than in *Cervulus*, *Mazama*, or *Cephalophus*. The humerus is not completely preserved in any of our specimens, and I do not observe any significant differences from the small modern Pecora.

The radius and ulna are separate throughout, the ulnar shaft very thin and flat, but retaining a considerable depth throughout. The radial shaft is moderately curved, as in *Merycodus*. The carpus is not complete in any of our specimens, the proximal row is preserved in No. 13822, but I do not observe any very significant differences from modern deer except in the greater vertical diameters of the bones.

The metacarpus is remarkably primitive. The lateral digits were apparently complete, and less reduced than in *Tragulus*; the cannon bone, however, is perfectly formed, and of true pecoran type, and the distal keels complete even upon the small lateral metacarpals. In *Dremotherium* the lateral metacarpals are complete[1] but reduced to filiform vestiges; in *Moschus* the lateral digits are comparatively large, but the shafts of the metapodials are not complete in either fore or hind foot, only proximal and distal ends being preserved. In *Merycodus*[2] the lateral digits in both fore and hind feet are reduced to very small vestigial remnants of proximal and distal ends of metapodials and tiny phalanges with flat facets. In most of the deer and all of the Bovidæ the distal remnants of the lateral metacarpals have disappeared, only the phalanges being represented. In *Antilocapra* and *Giraffa* the lateral digits are entirely gone.

The phalanges of the median pair of digits are comparatively long in *Blastomeryx*, as compared with *Merycodus*, in agreement with the Cervine affinities of the one and the antelopine affinities of the other genus.

Hind Limb.— The pelvis is distinctly Pecoran in type, and differs widely from that of *Tragulus* in the angulation between pre- and post-acetabular bars, the eversion of the upper end of the ilium and greater development of its superior plate.

The femur is more primitive than in any modern deer, less so than in *Tragulus*. This is seen especially in the comparatively narrow patellar trochlea facing more anteriorly and less distally than in modern deer, indicating a less horizontal position of the femur and the thigh more free from the flank.

The tibia presents no especial peculiarity. The distal rudiment of the fibula is quite as much reduced as in *Merycodus*, the shaft being represented by a very small, short spine.

The hind foot is decidedly more advanced than the fore foot, the lateral digits being reduced to short splints proximally; presumably distal rudiments were also present, but they are not preserved in our specimens. The proximal splint of Mts. ii is partially coössified with the cannon bone, the splint of Mts. v is free in all our specimens. The tarsus affords no very significant characters; it is much like that of *Merycodus* and of the smaller Cervidæ. The metatarsus is consolidated into a cannon bone, typically pecoran, somewhat shorter and more robust than in *Merycodus*, the distal keels complete. As in *Merycodus* and in all primitive pecora the median furrow is strong and well defined. This furrow is generally present in modern pecora, but more or less obliterated. It is entirely absent in the Camelidæ, fairly well marked in *Tragulus*, but of somewhat different form. The phalanges, like those of the carpus, are relatively long.

---

[1] Gaudry, Enchainements, III, p. 108, fig. 142.
[2] Matthew, 1904, figs. 13–14.

The limb and cannon bones in these Lower Miocene species of *Blastomeryx* are materially shorter and more robust than in *Merycodus*, but in species from the Middle and Upper Miocene the distinction is less apparent.

2. *Species of Blastomeryx.*

Three Lower Miocene species are represented in our collections, as follows:

B. advena Matthew, 1907: smaller, teeth more compressed, p_1 absent, fourth upper and lower premolar more rounded or oval in form, limbs and feet very small.

B. primus sp. nov. Larger, teeth broader, p_1 vestigial and spaced. $P\frac{4}{4}$ as in *B. advena*. Limbs and feet nearly two fifths larger.

B. olcotti sp. nov. Size of *B. primus*, but $p\frac{4}{4}$ more triangular in outline, p_1 less reduced and in series with p_2–m_3. Limbs and feet one-fourth larger than in *B. advena*.

The following measurements give the proportionate size of the three species.

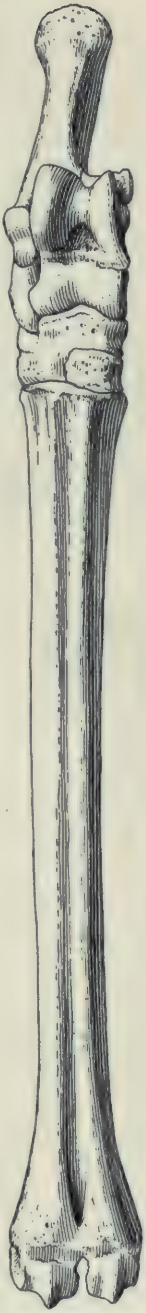


Fig. 7. *Blastomeryx olcotti*, Type, No. 13224. Hind foot, natural size.

	advena	*primus*	*olcotti*
	mm.	mm.	mm.
Length p_2–m_3	46	49	49
Transverse diameter of m_3	5.7	6.4	6.1
Length of metatarsus	100	140	125

The type of *B. advena* is a lower jaw, No. 13014. I refer to the same species No. 13015, the anterior part of a skull, fore and hind feet, pelvis, most of the vertebral column and ribs, and parts of limb bones; No. 13823 hind foot; all from the Upper Rosebud of South Dakota.

The type of *B. primus* is No. 13822, skull, jaws, fore and hind limbs and feet, atlas, and other vertebræ. No. 13016, lower jaw, altas, and scapula, is referred to the same species. Both are from the same level and locality as the preceding.

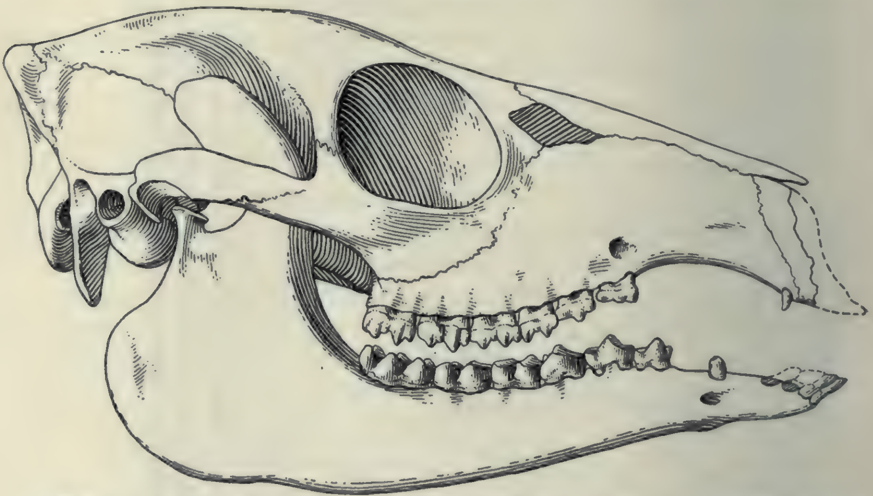


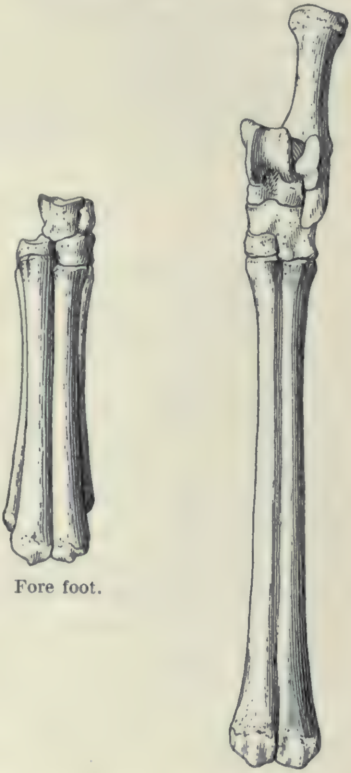
Fig. 8. *Leptomeryx evansi*, skull and jaws, natural size. No. 11870, Middle Oligocene, South Dakota.

The type of *B. olcotti* is No. 13224, upper and lower jaws, hind limbs and feet; 13224*a* lower jaw and hind foot of a younger individual was found associated with the type specimen. Both are from the "Arickaree" formation south of Lusk, Wyoming. This species is more primitive in its premolar construction than the two preceding, and the associated fauna has a somewhat older facies than that of the Upper Rosebud, but corresponds closely with that of the Upper Harrison beds immediately to the eastward, with which this "Arickaree" is probably continuous.

Comparison with the type species, *B. gemmifer*, is difficult on account of the imperfection of the type. The referred specimen No. 9449[1] is a trifle larger than *B. advena* and differs in the form of p_4, broader anteriorly and narrower posteriorly, so as to have a more quadrate outline; and in the greater proportionate length of the hind cannon bone, consolidation of Mts. ii with the cannon bone, and other details indicating a more advanced stage. The type specimen of *B. gemmifer* is a third lower molar and is a little larger and more robust, agreeing more nearly with *B. primus* and *olcotti*, and not clearly separable from them; but probably if it were better known its stage of evolution would be demonstrably more advanced, as it is in the referred specimen from the same level and locality, the Middle Miocene, Pawnee Creek beds of Colorado.

B. wellsi[2] of the Upper Miocene differs in more reduced premolars, molars larger and somewhat longer crowned; and a referred specimen shows the jaw to be very long and slender anteriorly.

Professor Scott has described[3] and referred to *Blastomeryx* a species from the "Loup Fork," probably Upper Miocene, which is much more advanced in skull and skeleton structure than those on which the preceding description is based. It is of much larger size; bears a small or rudimentary antler; the orbits are more prominent; the ulnar shaft is reduced to "a mere thread of bone"; the lateral digits are much more reduced and the shafts of the lateral metacarpals incomplete. This cannot well be congeneric with the Lower Miocene species, whether or not it be regarded as derived from them. If we do so regard it, *B. gemmifer* would probably represent an intermediate stage, as is indicated, in fact, by the little we know of it. In view of the near agreement in size and other characters between



Fore foot.

Hind foot.

Fig. 9. Fore and hind feet of *Leptomeryx evansi*, natural size. No. 6782, Cope Collection. Middle Oligocene, Colorado.

---

[1] Matthew, 1904, p. 124, fig. 17.
[2] *Ibid.*, p. 125, figs. 18–19.
[3] Bull. Mus. Comp. Zoöl., 1890, Vol. XX, p. 76.

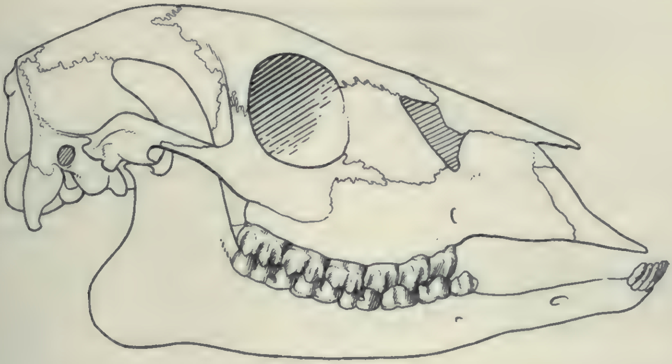
B. gemmifer and the Lower Miocene species, it seems preferable to place the latter in *Blastomeryx*, and regard the species described by Scott as referable to a more advanced genus, with rudimentary antlers and with the lateral digits of the fore foot incomplete. It seems inadvisable to name the Upper Miocene genus until we know something more definite of its dentition and skull characters, and its distinctions, if any, from *Mazama*.

Blastomeryx antilopinus Scott, 1894, and *B. borealis* Cope, 1878, with *Palæomeryx americanus* and *madisonius* Douglass, 1900, belong to a larger, more brachyodont phylum of Cervidæ, with supraorbital horns (or antlers) of peculiar type. They are distinct from *Blastomeryx*, probably also from the true *Palæomeryx*, but at present of uncertain relationship.

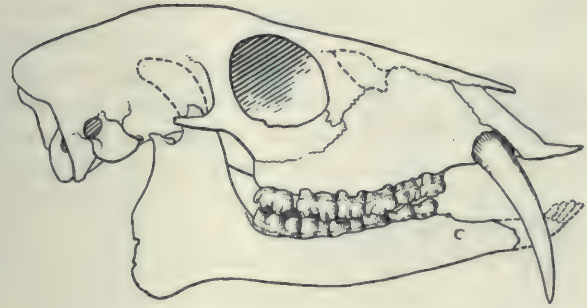
3. *Relationship to the Cervidæ.*

Structurally *Blastomeryx* is most nearly related to the musk-deer, but might stand in a general ancestral relation to the Cervidæ and especially to the smaller American deer. Its geological and geographical distribution would prevent its being regarded as actually ancestral to *Moschus* or to the Cervidæ generally, for we find in the Upper Oligocene of Europe genera more nearly representing the hypothetic ancestors of this family. *Blastomeryx* must be regarded, therefore, as a persistently primitive type, which may be ancestral to *Mazama* and perhaps *Odocoileus* but hardly to any of the remaining Cervidæ. Its structural resemblance to *Moschus* is greater than to any other living genus. But in view of the fact that genera closely related to *Blastomeryx* inhabited Europe at a somewhat earlier epoch, it is obviously more probable that *Moschus* is a little altered descendant of one of the primitive Cervidæ of the Old World, than that it is actually descended from the American genus.

The more typical modern Cervidæ have been divided (Brooke, 1878) into two groups. In one (Plesiometacarpalia) the distal end of the lateral metacarpals has entirely disappeared, only short proximal splints remaining. In the other (Telemetacarpalia) the distal ends of the lateral metacarpals are retained as splints of various lengths, the proximal splints are either absent or else fused more or less completely with the cannon bone. The first group includes nearly all of the Old World deer; the second includes all the New World genera together with two or three exceptionally primitive Old World deer. (Of the three holarctic genera, *Cervus* ranks with the Old World, *Alces* and *Rangifer* with the New World deer, in accord with their principal distribution.) The Old World deer therefore are distinguished by the precocious reduction of the lateral metacarpals, while in the New World deer the reduction is retarded. This distinction corresponds to that between



MAZAMA.



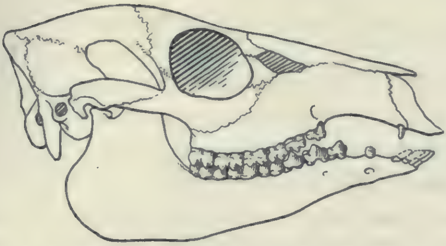
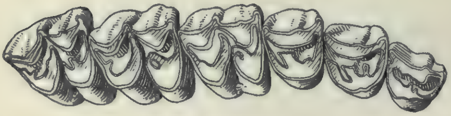


Fig. 10. Phylogeny of American Cervidæ. Skulls, half natural size. *Leptomeryx evansi* No. 11870 Middle Oligocene; *Blastomeryx primus*, No. 13822, Lower Miocene; *Mazama nemorivaga*, No. 15486, Recent (South America).

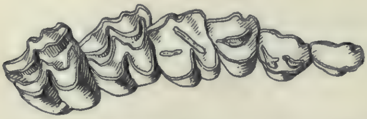
Blastomeryx and the contemporary European Palæomerycinæ. It appears probable therefore that if the Old World deer are derivable from *Dremotherium* and its allies, the New World deer are derivable from *Blastomeryx*.

4. *Trend of Evolution in the American Cervidæ.*

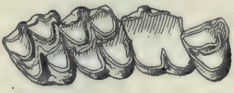
The structural changes necessary to convert *Blastomeryx* into the modern Cervid type may be summed up briefly, as they tend to show the trend of evolution in this phylum, a necessary preliminary to considering the derivation of the genus. These are:



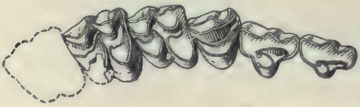
No. 15486. *Mazama nemorivaga.* Recent (South America).



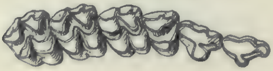
No. 13822. *Blastomeryx primus.* Lower Miocene (Upper Rosebud).



No. 13224. *Blastomeryx olcotti.* Lower Miocene ("Arickaree").



No. 13824. *Leptomeryx* sp. Lower Miocene (Lower Rosebud).



No. 11870. *Leptomeryx evansi.* Middle Oligocene (White River).

Fig. 11. Phylogeny of American Cervidæ. Upper teeth, natural size.

1. Increase in size and development of antlers. *Blastomeryx* stands 1 to 1½ feet high at the shoulders and is hornless. Rudimentary antlers appear in the larger Upper Miocene "Blastomeryx" according to Scott. The South American *Mazama* stands two feet high and has antlers ranging from simple spikes to two or three tines. The Sonoran *Odocoileus* stands three feet high and the antlers are three to five tined. The Nearctic species of Cervidæ stand four to five feet high, and the antlers are five to seven tined, or variously complicated.

2. Complication of the premolars by completion of their inner crescents. In *Blastomeryx* the inner crescent is complete only on p^4; on p^3 the inner cusp is low and partly connected by incomplete ridges with the posterior and anterior margins; on p^2 the inner cusp is low and small, with very rudimentary ridges. In *Mazama* the inner crescent is complete on p^{3-4}, low and imperfect on p^2. In *Odocoileus* it is complete on p^{2-4}, but still low and a little irregular on

p^2. In *Cervus* it is more nearly perfected on p^2, and in *Rangifer* it is quite perfected. The lower molars show a corresponding change in the complication of their inner sides. In *Blastomeryx* there are three marked transverse ridges on the inner side of the tooth, separated by open valleys. In *Mazama* p_4 and the posterior half of p_3 show strong crested inner cusps corresponding to the inner crescents of the molars, partially united with the transverse ridges. In *Odocoileus* the anterior half of p_4 has become completely molariform, the posterior half somewhat degenerate (corresponding to absence of a posterior crescent on the upper premolars); p^3 also shows a strong high pillar on the inner side of the median crest. Evidently this tooth is not exactly analogous in its process of complication with the adjoining one. In *Cervus, Alces,* and *Rangifer* the process of complication is carried farther but not by identical methods, so that it is inadvisable to state it in detail.

3. Reduction of the upper canines. In *Blastomeryx*, as in other Miocene Cervidæ and a few modern survivals, they are long, slender laniary tusks. In *Mazama* they are quite small but usually present in the milk, less generally in the permanent dentition; in *Odocoileus* they are never present in the permanent dentition.

4. Disappearance of the "Palæomeryx fold" on m_{1-3}. It is vestigial in the Lower Miocene species, apparently absent in Middle Miocene species, certainly absent in Upper Miocene species of *Blastomeryx*. In the larger and more brachyodont American Miocene species referred to *Palæomeryx* it persists into the Upper Miocene. It is characteristic of all primitive Cervidæ (Palæomerycinæ), according to Schlosser, and absent in any of the late Tertiary and modern Cervidæ.

5. Broadening and shortening of the nasal bones. In *Blastomeryx* the nasals are long and very narrow, as in all the Oligocene ruminants (*Leptomeryx, Hypertragulus, Poëbrotherium,* etc.); in *Mazama* very much shortened and broadened, especially posteriorly; this change is carried a little farther in *Odocoileus*. The Camelidæ show a corresponding change from *Poëbrotherium* to the modern types; in *Tragulus*, however, the primitive form is retained.

6. Relative elongation of the lower parts of the limbs, associated with a more horizontal position of humerus and femur. Aside from the length and curvature of the bones, the shortening and more distal position of the patellar trochlea furnishes a convenient index of this change.

7. Reduction of the ulnar shaft.

8. Considerable reduction of the lateral metacarpals. In *Blastomeryx* the lateral metacarpals are slender but apparently complete. In *Mazama* the distal splints are half the length of the shaft. In *Odocoileus, Rangifer*

and *Alces* the distal splints are much shorter, and in *Cervus* they have completely disappeared, only the phalanges being left.

9. Very slight reduction of the lateral metatarsals.

10. Sharper definition of the dorsal portions of the distal keels of the metapodials, narrowing and elongation of the metacarpal cannon bone, partial obliteration of the median furrow on the metatarsal cannon bone, and various minor changes which need not be recapitulated.

5. *Relationship to European Oligocene Selenodonts.*

The close resemblance of *Blastomeryx* to *Dremotherium* and *Amphitragulus* in dentition and general skeletal characters has been pointed out. It is, however, somewhat more primitive in dentition, and considerably more primitive in skeleton characters, although occurring in a geologically later stage. The ruminant genera from the earlier Oligocene of Europe are more primitive in dentition, but in none of the better known genera is the condition of the manus and pes such as we should expect to find in an ancestor of *Blastomeryx*. In *Prodremotherium*, although the cannon bones are less

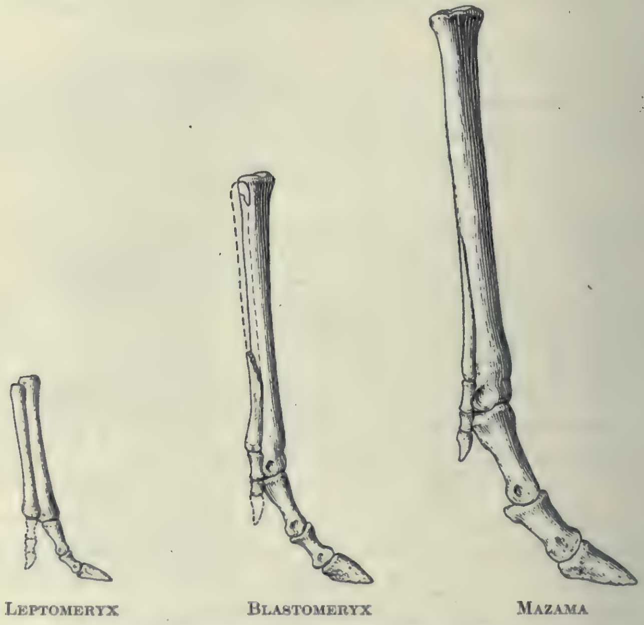


Fig. 12. Phylogeny of American Cervidæ. Fore feet, half natural size. *Leptomeryx evansi*, No. 6782; *Blastomeryx advena* No. 13015; *Mazama nemorivaga*.

completely formed than in *Blastomeryx,* the lateral metacarpals are much more reduced; and the same is true of the more primitive genera *Lophiomeryx* and *Gelocus,*[1] although the metapodials in these genera are not soldered together and their distal keels are confined to the plantar surface. It appears, therefore, that *Blastomeryx,* cannot be derived from any of the known Euro-

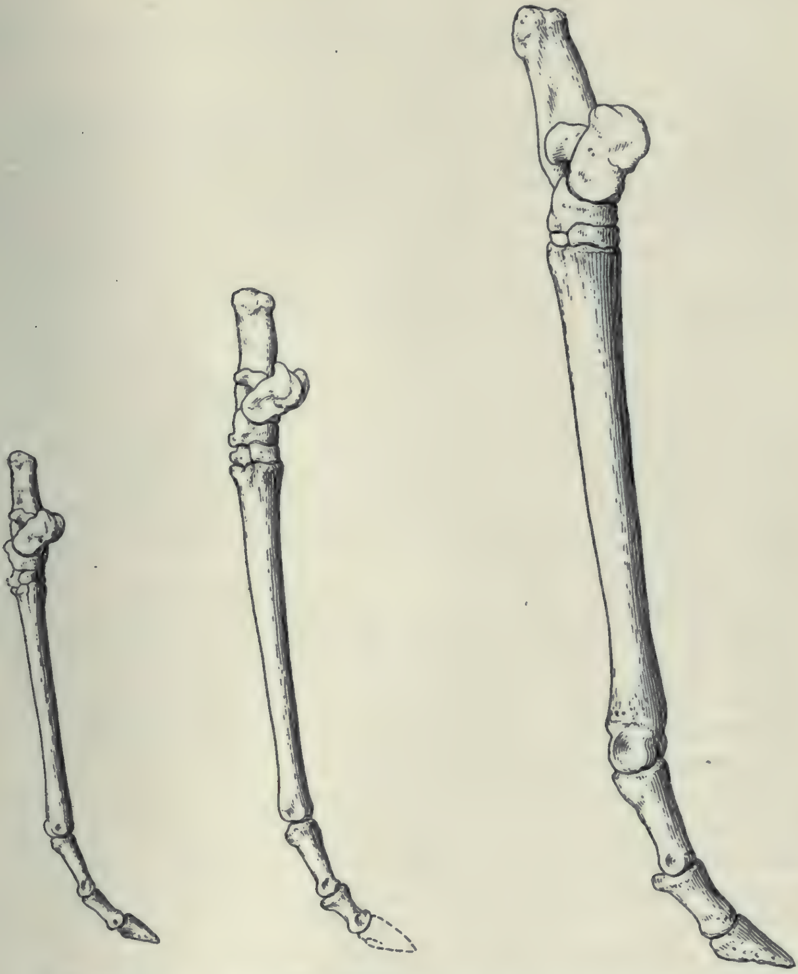


Fig. 13. Phylogeny of American Cervidæ. Hind feet, half natural size. From the same individuals as Fig. 12.

---

[1] Cf. Zittel, 1893; Kowalevsky, 1876.

pean selenodonts, but represents a phylum of Cervidæ in which the reduction of the lateral metacarpals was exceptionally retarded in relation to other progressive characters. This feature, as we have seen, is distinctive of the American deer.

6. *Relationship to Leptomeryx.*

Among the American Oligocene selenodonts *Leptomeryx* appears to fulfil accurately the theoretical requirements for an ancestor of *Blastomeryx.* This interesting little genus has been placed with the Tragulines by Leidy,[1] Cope,[2] and Scott,[3] with the Tylopoda by Rütimeyer[4] and by Scott[5] in his later studies: while Dr. Schlosser[6] has regarded it as ancestral to the Ovinæ. The present writer has dissented from all these views and regarded it as an independent offshoot of the Pecoran-Traguline stock.[7] The skeleton characters of *Blastomeryx* throw considerable new light on the question, for they show in one phylum of Cervidæ a marked approximation to the characters of *Leptomeryx* in teeth, skull, and skeleton characters. A re-study of *Leptomeryx* brings out the fact that it has numerous indications of relationship with the Pecora, especially with the primitive Cervidæ, rather than with *Tragulus* or the Camelidæ, although they have been obscured by the broad differences which now appear to be primitive characters, partly bridged over by *Blastomeryx.* These are:

(1) The pattern of the upper molars is that of the primitive Cervidæ, with prominent mesostyle, strongly convex paracone rib, and flat metacone rib. In *Tragulus* and *Hypertragulus* the mesostyle is absent, and both external ribs developed; in *Protoceras, Heteromeryx,* and the earlier brachyodont Camelidæ the mesostyle is present and both ribs are usually equally developed, as they are in most modern Pecora.

(2) The lower molars have the Palæomeryx fold peculiar to the primitive Cervidæ. This fold is not present in *Hypertragulus, Hypisodus, Heteromeryx, Protoceras, Poëbrotherium* or *Paratylopus.* It is present, according to Schlosser, in all the Palæomerycinæ but absent in all other primitive Pecora.[8] It is therefore not a common primitive ruminant character, nor is it found with any brachyodont dentition except in the Cervid phylum. I have not detected it in any of the Uinta selenodonts. Its presence is a strong argument for Cervid affinities.

---

[1] Leidy, 1869, p. 165 ("Moschidæ" = Tragulidæ of later authors, with *Moschus* included).
[2] Cope, 1887, p. 389.
[3] Scott, 1891.
[4] Rutimeyer, 1883, p. 98.
[5] Scott, 1899, pp. 15 et seq.
[6] Schlosser, 1904, p. 90.
[7] Matthew, 1905, p. 25.
[8] Excepting certain Gelocidæ and early Cervinæ. Schlosser, 1902, 1903.

(3) The premolars are fairly large and their pattern is very much like that of *Blastomeryx,* only more simple and trenchant and the inner crescents of p^{2-3} more rudimentary. The first upper premolar has already disappeared, and the first lower premolar is small and one-rooted. The principal diastema in the lower jaw is in front of p_1, the lower canine is incisiform. The upper canine is small and so far as known its great development in the primitive Cervidæ is not foreshadowed in *Leptomeryx.* In *Tragulus* the premolar pattern is much simpler and more trenchant; in the camels the premolars are much more compressed, the internal ridges fewer and differently placed, and the teeth are early reduced in number and size except $p\frac{1}{1}$, which are placed more anteriorly and tend to become caniniform instead of disappearing. In *Hypisodus* and *Stenomylus,*[1] which appear to have cameline affinities, p_1 is placed still farther forward and becomes incisiform.

(4) The face is moderately long and agrees very well with *Blastomeryx* in form. It does not show the broadening of the supraorbital region and extreme pinching in beneath the nasals that characterizes the camels, nor the thick, heavy muzzle of the Tragulines. The nasal bones are long and narrow, as in all primitive ruminants, but agree much more nearly with *Blastomeryx* than with *Poëbrotherium,* and are entirely unlike any of the later Camelidæ but not unlike those of *Tragulus.* The basicranial region is also much like that of *Blastomeryx,* the bullæ are more inflated than in that genus, and are quite different from the types of bulla characteristic of *Tragulus* and of the camels.

(5) The neck is short and the vertebræ normal, a most important distinction from any of the Camelidæ.

(6) The fore foot is of very primitive type, the metapodials separate, the lateral digits functional, the metapodial keels incomplete. This is in marked contrast with the conditions in the modern Cervidæ, but in view of the remarkably primitive conditions in *Blastomeryx* we may expect that its Oligocene predecessors would be exceptionally primitive in the condition of the manus. On the other hand, in the camels the reduction of the lateral digits occurs very early, and long before the coössification of the median pair. To a less extent the same is true of the Traguline line, and apparently of some phyla of Pecora.

(7) The pelvis of *Leptomeryx* is much like that of *Blastomeryx* and the Cervidæ; well distinguished from that of *Tragulus* and *Hypertragulus* by the characters which I have cited in describing *Blastomeryx.*

(8) The distal rudiment of the fibula remains free, as in Pecora and Camelidæ; in *Tragulus* and its Oligocene relative *Hypertragulus,* and even in certain Bridger selenodonts of unknown affinities, the rudiment is coössified with the tibia.

---

[1] Peterson, 1907, Ann. Carnegie Mus., Vol. IV, (1906), p. 41.

(9) The magnum is coössified with the trapezoid and the navicular with the cuboid as in Pecora and Tragulina. In the Tylopoda they are invariably separate.

(10) The median metatarsals are coössified into a cannon bone of distinctively pecoran type, except in the incomplete distal keels. The median groove is precisely like that of *Blastomeryx.* This groove is somewhat different in form in *Tragulus*; in the Camelidæ there is no trace of it. The head of the cannon bone has the round-quadrate form of the pecora and tragulines, lacking the long plantar projection formed of the combined proximal plantar processes of the metapodials, which are especially prominent in the earlier Camelidæ but characteristic of the family as a whole. The shaft of the cannon bone is approximately symmetrical, subquadrate in section; in *Tragulus* the dorsal surface of the shaft of Mts. iii is high and crested, and of Mts. iv depressed and obliquely flattened, and the shaft has a trihedral outline.

(11) In both fore and hind feet the distal keels of the metapodials, although completely developed only on the under side, are carried forward on the dorsal side as low, flat ridges, or rudimentary keels, no trace of which appears in any of the Camelidæ. In *Tragulus* the position of the keel is much more lateral — a quite exceptional condition — in *Hypertragulus* the dorsal parts of the distal facets are uniformly convex, as in unguiculates; in the successive members of the Camelid series we see the lateral convexity gradually flattened out, as generally among ungulates, but no attempt to extend the plantar keel dorsad.[1]

(12) The phalanges of *Leptomeryx* are of the compressed pecoran-traguline type, notably different from those of the later camels, less so from those of *Poëbrotherium.*

The above characters appear to me to show conclusively that *Leptomeryx* is of pecoran affinities, not traguline nor tylopod. The features in which it differs from Pecora and resembles either *Tragulus* or the Camelidæ appear on examination and in view of the characters and relations of *Blastomeryx*, to be all primitive conditions lost by the first and retained by the other two groups.

The presence of the Palæomeryx fold in the lower molars is distinctive of the primitive Cervidæ, according to Schlosser, and would exclude the genus from ancestral relationship to any of the Cavicorn groups.[2] *Leptomeryx* cannot, therefore, by Schlosser's own criteria, be ancestral to the

---

[1] The eversion of the distal ends of the cannon bone characteristic of the later camels, is said by Scott (1899, p. 17) to occur in a slight degree in *Leptomeryx*; but it is certainly no greater in this genus than in *Blastomeryx*, and, therefore, has no weight as evidence of tylopod relationship.

[2] Schlosser, 1904, p. 107.

Ovinæ, as he supposes it to be. Dr. Schlosser appears to have been the first to recognize its pecoran affinities, however, and his extensive and thorough studies of the fossil ruminants of the Old World lend especial weight to his opinion.

The above comparisons and contrasts with the Tragulines have been made with *Tragulus* and *Hypertragulus* only, excluding *Dorcatherium* because an examination of that genus leads me to believe that it is, in fact, a very primitive offshoot of the pecoran stock, having no especial relations with *Tragulus*, the common characters being simply persistent primitive features. The relations of the alleged tragulines of the European Oligocene appear to be also open to question. The exact relations of the Uinta selenodonts I am likewise compelled to regard as an unsettled question. Professor Scott is no doubt correct in regarding all of them as comparatively nearly related to each other; but I am not clear that even *Protylopus* is directly ancestral to *Poëbrotherium*, although there is a fair amount of evidence for tylopod affinities. In the other genera the relationship is far from conclusively shown to the primitive Tylopoda as distinct from primitive pecora or tragulines. Indeed it might be better in systematic arrangement to retain the Hypertragulidæ as the primitive group from which the specialized Tylopoda, Tragulina, and Pecora are derived, and to include with them all the Eocene selenodonts with tetradactyl manus, didactyl pes, slender muzzle and four crescents on the molars. This need not prevent our regarding *Leptomeryx* as of pecoran, *Hypertragulus* of traguline, and *Protylopus* of tylopod affinity.

The conclusions may be summed up as follows:

(1) *Leptomeryx* is an extremely primitive, unspecialized genus of pecoran stock.

(2) It is related especially to the primitive Cervidæ.

(3) It fulfils every structural requisite for a direct ancestor of *Blastomeryx*, and no other known genus does so.

(4) Its occurrence in the American Oligocene, contemporary with much more advanced Pecora in the Old World precludes regarding it as genetically ancestral to the Cervidæ as a whole. It may be ancestral through *Blastomeryx*, however, to the American deer.

Occurrence of Leptomeryx.— The genus appears first in the Lower White River, Titanotherium Beds. At least three species are represented (two described) by jaws and teeth, but the structure of the skull and skeleton is unknown. In the Middle White River, Oreodon Beds, *L. evansi* is the only clearly defined type, and the generic characters and comparisons are based upon this species. In the Upper White River, Protoceras and Leptauchenia Beds, several undescribed species are represented by jaws and incomplete skulls. The genus is not found in the John Day, but in the Lower Rosebud occurs a large species, Fig. 11 (No 13824). with the dentition of *Leptomeryx* and intermediate in size between *L. evansi* and *Blastomeryx advena*. A smaller species with more advanced premolar dentition, *L. transmontanus*, is reported by Douglass from supposed Uppermost Oligocene beds in Montana. The skull and skeleton are unknown in these later species; the teeth show but a limited degree of approximation to *Blastomeryx*, so that it is not probable that they are exactly intermediate.

7. *Interpretation of the Phylogeny.*

If this phylum be regarded as approximately true in a genetic, as it is in a structural sense, we must regard the direct genetic phylum as carried through early species of the genus, probably unknown to us at present, the region of evolution of the race and its centre of dispersion lying far to the north and perhaps Asiatic rather than American. The species known to us represent successive migrations from this boreal center, driven over to the southward before the competition of the higher types evolved in the center of dispersion. These migrant types continue to evolve in certain respects, such as brain capacity, which are advantageous in any habitat, but preserve most of their primitive characters as the environmental pressure is less in amount and more variable in direction. Thus it is obvious that the modern deer of the New World, taken geographically from south to north, represent approximately those stages in the evolution of the group which we would expect to find in the Pliocene to recent formations of the Northwest. Had the connection with South America existed before the Pliocene we might expect to find, far to the south, representatives of still earlier stages. And if there were great islands adjoining South America and connected with it at times during the Tertiary we might find in them living representatives of the Oligocene or Eocene ancestors of our Cervidæ. Such is not the case, however.[1] The New World has preserved nothing of the early Tertiary fauna of the north, and the nearest equivalent stages and representatives of our Eocene and Oligocene faunæ are found in the East Indies and in Madagascar, where they represent rather the Old World divisions of the various holarctic groups of the early Tertiary.

From this point of view it seems fair to say that the genera *Leptomeryx*,

---

[1] The Antilles and the Galapagos and Falkland Islands might be cited as exceptions to this statement. With regard to the two former it is sufficient to say that their fauna is strictly confined to such types as might conceivably have reached the islands by transportation over sea from South America in the direction of the prevailing ocean winds and currents. Those which could not have done so are absent. The Falkland Islands were almost certainly connected with the mainland at times during the Tertiary, but their small size and the unfavorable physical conditions have prevented the survival of any of the Tertiary types such as have been preserved to our time with but little alteration in the great tropical islands of the Old World.

Blastomeryx, *Mazama*, *Odocoileus*, and the large Nearctic Cervidæ, are structurally and genetically connected but it would be incorrect and misleading to attempt to carry the line through the known species. The fossil species in successive levels in the same locality will show usually successive approximations toward the next higher generic stage. But all are approximately, not exactly, in genetic succession, and we cannot draw from them conclusions as to whether the evolution was spasmodic or continuous, constant or variable in its direction, and in our attempts to discover the underlying causes of the progress of the race, we must keep always in mind that we are dealing usually with an approximate, not an exact phyletic series.

With this reservation, which in my opinion applies equally or more emphatically to most of the accepted phyletic series of fossil mammals, I believe that we can trace the ancestry of the American Cervidæ back to *Leptomeryx*. If Professor Scott is correct in regarding *Camelomeryx* of the Uinta as ancestral to *Leptomeryx*, the series is carried one step farther back. But *Camelomeryx* cannot be directly ancestral to *Leptomeryx*, and I suspect that if it is ancestral to any of the Hypertragulidæ its affinities are rather with *Heteromeryx*, of the Lower White River.

Evolution and Migration of the American Deer.

The accompanying diagram attempts to illustrate the succession and southward march of the known stages of this phylum. *Leptomeryx* is the first, ranging through the Oligocene and into the earliest Miocene in the West, precluded from reaching South America by the supposed geographic isolation of that continent during the Miocene. We might look for survivors of this stage in Miocene deposits of Mexico or Central America, if these were better explored.

Blastomeryx ranges through the Miocene of the western United States, and it is possible that the later species may have reached South America and may yet be discovered in the Pliocene of that country.

Mazama is known from the Pleistocene of South America and still inhabits that country. It should appear in the Pliocene faunæ of North America, which are as yet very imperfectly known.

Odocoileus appears in the early Pleistocene of North America and is a typically Sonoran genus in its present range.

Cervus (*canadensis* group), *Rangifer* and *Alces* first appear in America in the later Pleistocene and their typical range is holarctic.

It is hardly necessary to say that these evolutionary stages and generic ranges are approximate, not exact. They are sufficiently so to prove the progressive southward movement of successively higher stages in the evolution of the American Cervidæ, and to indicate their origin as on the Nearctic side of a Holarctic centre of dispersion.

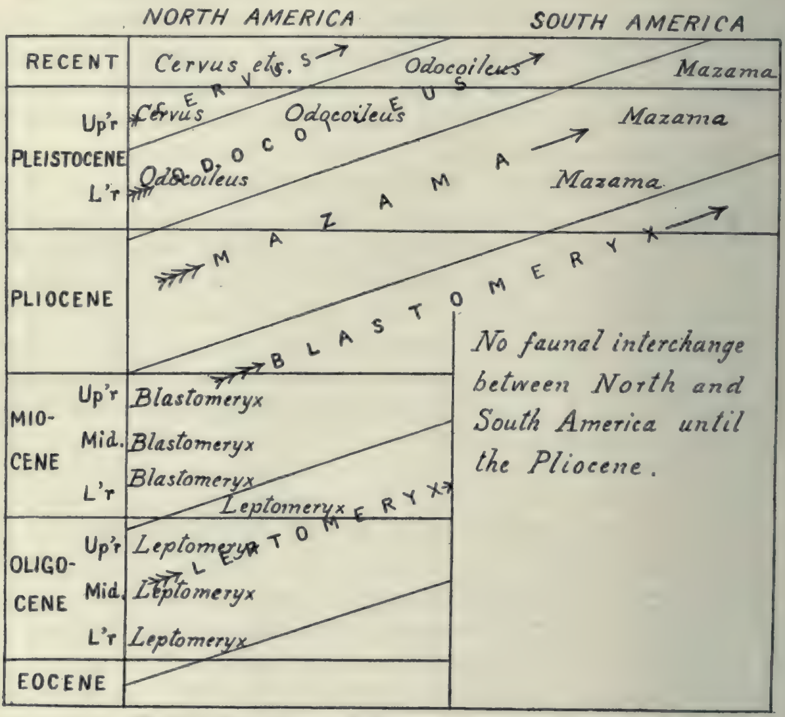

NORTH AMERICA
SOUTH AMERICA
RECENT
Cervus etc.
Odocoileus
Mazama
Up'r
PLEISTOCENE
L'r
Cervus
Odocoileus
Mazama
Odocoileus
Mazama
CERVUS
ODOCOILEUS
MAZAMA
PLIOCENE
BLASTOMERYX
MIO-CENE
Up'r
Mid.
L'r
Blastomeryx
Blastomeryx
Blastomeryx
Leptomeryx
LEPTOMERYX
OLIGO-CENE
Up'r
Mid.
L'r
Leptomeryx
Leptomeryx
Leptomeryx
EOCENE
No faunal interchange between North and South America until the Pliocene.

Fig. 14. Evolution and Migration of American Cervidæ.

The evolutionary history of the American Cervidæ is paralleled by that of most of the phyla of the Tertiary mammalia, as I interpret them. With a very few exceptions they can best be understood as a general movement of dispersal from a Holarctic, Nearctic or Palæarctic center of evolution. The geographic distribution of modern mammals taken by itself has long been understood in this way; and so far as the imperfect records of palæontology go, they appear to me to verify, as accurately as could be expected, the inferences from modern distribution and to indicate northern Asia as the great center of dispersion of the mammalia. Our lack of knowledge of the older Tertiary faunæ of Asia has obscured the force of this agreement, and militates against the exactness of all of our accepted phylogenies. When this gap is filled we may have exact phylogenetic series; until then they are approximate. Thus it happens that in Europe, on one side of this centre,

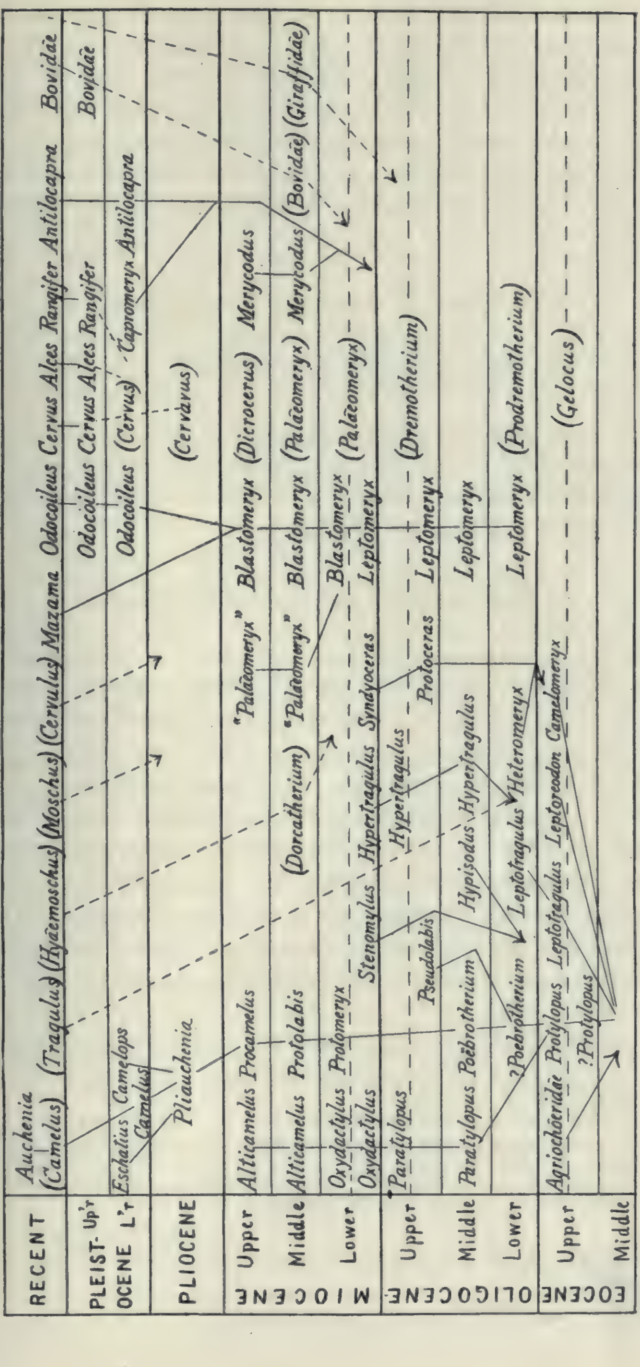

RECENT
PLEISTOCENE Up'r
L'r
PLIOCENE
MIOCENE
Upper
Middle
Lower
OLIGOCENE
Upper
Middle
Lower
EOCENE
Upper
Middle
Auchenia (Camelus) (Tragulus) (Hyaemoschus) (Moschus) (Cervulus) Mazama Odocoileus Cervus Alces Rangifer Antilocapra Bovidae
Odocoileus Cervus Alces Rangifer Bovidae
Eschatius Camelops Camelus Odocoileus (Cervus) Capromeryx Antilocapra
Pliauchenia (Cervavus)
Alticamelus Procamelus "Palaeomeryx" Blastomeryx (Dicrocerus) Merycodus
Alticamelus Protolabis (Dorcatherium) "Palaeomeryx" Blastomeryx (Palaeomeryx) Merycodus (Bovidae) (Giraffidae)
Oxydactylus Protomeryx Blastomeryx (Palaeomeryx)
Oxydactylus Stenomylus Hypertragulus Syndyoceras Leptomeryx
Paratylopus Hypertragulus (Dremotherium)
Pseudolabis Protoceras Leptomeryx
Paratylopus Poëbrotherium Hypisodus Hypertragulus Leptomeryx
?Poebrotherium Leptotragulus Heteromeryx Leptomeryx (Prodremotherium)
Agriochoeridae Protylopus Leptotragulus Leptoreodon Camelomeryx (Gelocus)
?Protylopus

Fig. 15. Phylogeny of American Ruminants.

in America, on the other side, we have parallel series of approximate phylogenies; sometimes closer in the one country, sometimes in the other. The southern continents, cut off during the early Tertiary from the northern, developed their faunæ independently; but these faunæ originated from primitive types which are certainly present in the early Eocene faunæ of the northern world, and may quite well be regarded as a similar but earlier dispersal from a northern origin. This subject is too broad to be considered here, however.

PHYLOGENY OF AMERICAN RUMINANTS.

8. *Phylogeny of American Ruminants.*

In the diagram (Fig. 15) I have attempted to show the occurrence and approximate phylogeny of the American ruminants, together with a few of the more important Old World types. The Old World genera are in brackets, and Old World phyla in dotted lines.

9. *Key to the Classification of Ruminants.*

In the following arrangement I have indicated the primary progressive stages by numerals (I, II, III; 1. 2.) the divergent group characters by letters (A, B, C; a, b, c; α, β). The characters selected are merely those necessary for an analytical key; they are not the whole nor always the most important or distinctive characteristics of the several groups.

Dorcatherium and *Hyæmoschus* would in this arrangement fall more readily in the second division under the Hypertragulidæ, as a distinct subfamily. It will readily be understood that the horizontal (numerical) divisions are of necessity arbitrary lines. With a complete knowledge of fossil Artiodactyla every intermediate stage would appear, and the point at which the lateral digits become vestigial rather than functional is not easy to define.

The families of the higher Artiodactyla may be defined as follows:

Molars selenodont, quadricuspid.

I. Manus and pes functionally tetradactyl.

1. Upper molars with strong parastyle and mesostyle and usually a metastyle, but no external ribs on paracone or metacone. Muzzle short and broad, c^1 and p^1 stout, caniniform, diastemata short or absent *Agriochæridæ* (*Oreodontidæ*).

II. Manus tetradactyl, pes functionally didactyl. Muzzle slender, as in the following groups . . . . *Hypertragulidæ*.

1. Podial bones separate.

a. Upper molars with parastyle, mesostyle and both external ribs prominent . . . . *Leptotragulinæ.*

2. Navicular-cuboid and magnum-trapezoid coössified.[1]

b. Upper molars with parastyle, mesostyle and anterior external rib prominent. Premolars well devêloped . . . . *Leptomerycinæ.*

c. Upper molars with parastyle, mesostyle and both external ribs prominent. Premolars well developed . . . . *Protoceratinæ.*

d. Upper molars without mesostyle, both external ribs prominent. Premolars simpler, trenchant . . . . *Hypertragulinæ.*

e. Molars narrow, hypsodont, premolars much reduced, p_1 incisiform. *Hypisodontinæ.*

III. Manus and pes didactyl.

A. (Tylopoda) Podials separate. I^{1-2} disappearing, i^3, $c\frac{1}{1}$; $p\frac{1}{1}$ becoming caniniform. Principal diastema behind $p\frac{1}{1}$. Molars very narrow, premolars small, progressively reduced. Digitigrade with progressive development of plantar pad *Camelidæ.*

B. Navicular-cuboid and magnum-trapezoid coössified. I^{1-3} absent. Molars broader, premolars less reduced. Unguligrade.

1. Distal keels of median metapodials incomplete dorsally (Tragulina).

a. Upper molars as in Hypertragulinæ. . . . . *Tragulidæ.*

b. Upper molars as in Protoceratinæ . . . . *Gelocidæ.*

2. Distal keels of metapodials completed dorsally (Pecora).

a. Upper molars as in Leptomerycinæ, premolars more or less complicated, p_1 behind principal diastema, vestigial or absent. Progressive development of antlers. *Cervidæ.*

b. Upper molars as in Protoceratinæ; premolars more or less complicated; dentition brachyodont. Progressive development of bony bosses on the skull. *Giraffidæ.*

c. Molars usually more hypsodont, but apparently derived from same pattern as in Protoceratinæ. Face depressed upon cranial axis.

α. Progressive development of antlers or deciduous horns . *Antilocapridæ.*

β. Progressive development of true horns . . . . *Bovidæ.*

The Pecora and Tragulina are derivable from the higher groups of Hypertragulidæ, which in common with the Camelidæ may be derived from the Leptotragulinæ. The Cervidæ are derivable from Leptomerycinæ, the Tragulidæ from Hypertragulinæ, the remaining Pecora more nearly from Protoceratinæ. The Hypisodontinæ are allied with the Tylopoda, and apparently not ancestral to any of the later groups.

The successive stages of specialization may be summed up as follows:

Toes 2–2	Camelidæ Cervidæ Bovidæ Giraffidæ Antilocapridæ Tragulidæ Gelocidæ	Selenodont; upper molars 4–cusped
Toes 4–2	Hypertragulidæ	
Toes 4–4	Oreodontidæ	
	Dichobunidæ	Bunodont. Upper molars 6–cusped
	Trigonolestidæ	“ “ “ tritubercular

---

[1] Variable in *Protoceros.*

Principal References.

1878. **Brooke, Victor**. On the Classification of the Cervidæ, etc. *Proc. Zool. Soc. London,* 1878, pp. 883–928, pl. lv.

1884. **Cope, E. D**. On the Structure of the Feet in the Extinct Artiodactyla of North America. *Proc. Am. Phil. Soc.*, Vol. XXII, pp. 21–27.

1887. **Cope, E. D**. Classification and Phylogeny of the Artiodactyla. *Proc. Am. Phil. Soc.*, Vol. XXIV, pp. 377–400.

1888–9. **Cope, E. D**. The Artiodactyla. *Am. Nat.*, Vol. XXII, pp. 1079–1095; *ibid.*, XXIII, pp. 111–136.

1900. **Douglass, Earl**. The Neocene Lake Beds of Western Montana. University of Montana, pub. July 1, 1900, auct. O. P. Hay.

1904(?) **Douglass, Earl**. New Vertebrates from the Montana Tertiary. *Ann. Carnegie Mus.*, Vol. II, (1903) pp. 145–200.

1876–77. **Filhol, H**. Recherches sur les Phosphorites du Quercy. *Ann. Sci. Géol.*, Vol. VII, pp. 1–220, pll. x–xxxvi; VIII, pp. 1–340, pll. i–xxviii.

1881. **Filhol, H**. Étude des mammifères fossiles de Saint-Gérand-le-Puy (Allier). *Ann. Sci. Géol.*, Vol. XI, pp. 1–86, pll. i–xx.

1891. **Flower & Lydekker**. Mammals Living and Extinct.

1876. **Kowalevsky, W**. Osteologie des Genus Gelocus. *Palæontographica*, Vol. XXII.

1896. **Lydekker, R**. A Geographic History of Mammals.

1869. **Leidy, Joseph**. Extinct Mammalia of Dakota and Nebraska. *Jour. Acad. Nat. Sci. Phila.*, Vol. VII, pp. 1–472, pll. i–xxx.

1901. **Matthew, W. D**. Fossil Mammals of the Tertiary of Northeastern Colorado. *Mem. Am. Mus. Nat. Hist.*, Vol. I, pp. 353–446, pll. xxxvii–xxxix.

1902. **Matthew, W. D**. The Skull of Hypisodus, with a Revision of the Hypertragulidæ. *Bull. Am. Mus. Nat. Hist.*, Vol. XVI, pp. 311–316.

1904. **Matthew, W. D**. A Complete Skeleton of Merycodus. *Ibid.*, Vol. XX, pp. 101–129, and plate.

1905. **Matthew, W. D**. Notice of Two New Genera of Mammals from the Oligocene of South Dakota. *Ibid.*, Vol. XXI, pp. 21–26.

1907. **Matthew, W. D**. A Lower Miocene Fauna from South Dakota. *Ibid.*, Vol. XXIII, pp. 169–219.

1864. **Milne-Edwards A**. Recherches anatomiques, etc., sur la Famille des Chevrotains. *Ann. Sci. Nat., Zool.* (5), Vol. II, pp. 49–167, pll. ii–xii.

1902. **Schlosser, Max**. Beiträge zur Kenntniss der Saügethiere aus den süddeutschen Bohnerzen. *Koken's Geol. u. Pal. Abh.*, Bd. V (IX), iii, s. 117–258, taf. vi–x.

1903. **Schlosser, Max**. Die fossile Säugethiere Chinas nebst einer Odontographie der recenten Antilopen. *Abh. k. bayer. Akad. Wiss.*, Cl. II, Bd. XXII, s. 1–221, taf. i–xiv.

1904. **Schlosser, Max**. Die Fossilen Cavicornia von Samos. *Beit. zur Pal. u. Geol. Ost.-Ung.*, Bd. XVII, s. 21–118, taf. iv–xiii.

1891. **Scott, W. B**. On the Osteology of *Mesohippus* and *Leptomeryx*, etc. *Jour. Morph.*, Vol. V, pp. 301–406.

1894. **Scott, W. B**. The Mammalia of the Deep River Beds. *Trans. Amer. Phil. Soc.*, Vol. XVIII, pp. 55–185, pll. i–vi.

1899. **Scott, W. B**. The Selenodont Artiodactyls of the Uinta Eocene. *Trans. Wagner Inst. Sci. Phila.*, Vol. VI, pp. 1–121, pll. i–iv.

Article XXVIII.— MYRIOPODA FROM PORTO RICO AND CULEBRA.

By Filippo Silvestri.

The Myriopoda hitherto recorded from Porto Rico number 12 species, viz: *Otocryptops melanostomus* Newp.; *Siphonophora portoricensis* Brandt; *Stemmiulus compressus* Karsch; *Iulus curiosus* Karsch; *I. cæsar* Karsch; *Spirostreptus sculpturatus* Karsch; *Spirobolus multiporus* Karsch; *Rhinocricus parcus*; *Rhinocricus arboreus* Sauss. var. *krugii* Karsch and var. *gundlachi* Karsch; *Odontopeltis mauritii* Brandt; *Tridesmus sectilis* Cook.

From Culebra, one of the Virgin Islands, no Myriopoda have been till now described or recorded.

In March, 1906, Prof. W. M. Wheeler, while visiting Porto Rico and Culebra, among other interesting specimens collected a number of Myriopods, representing 18 species, of which 5 belong to the Chilopoda and 13 to the Diplopoda. Of the former, one species (*Geophilus culebræ*), and of the latter, 6 species (*Rhinocricus modestior; Diopsiulus wheeleri; Microspirobolus insularis, Microspirobolus marmoratus; Tridesmus portoricensis; Lasiodesmus caraibicus*), are new to science.

Including Professor Wheeler's interesting collection the known Myriopods of Porto Rico are now as follows·

Chilopoda.

Otocryptops melanostomus.
Newportia ernsti.
Otostigmus caraibicus.

Diplopoda.

Lophoproctus?
Diopsiulus compressus.
Siphonophora portoricensis.
Iulus curiosus.
“ *cæsar.*
Orthoporus sculpturatus.
Rhinocricus parcus.
Rhinocricus arboreus v. *gundlachi.*
“ *modestior.*
Spirobolus multiporus.
Microspirobolus insularis.
“ *marmoratus.*
Orthomorpha coarctata.
Leptodesmus sallei.
“ *mauritii.*
Tridesmus portoricensis.
“ *sectilis.*
Lasiodesmus caraibicus.

From Culebra we know at present:

Chilopoda.

Cupipes? ungulatus.
Geophilus culebræ.

Diplopoda.

Rhinocricus arboreus.
Diopsiulus wheeleri.

Among the Diplopoda of Porto Rico and Culebra here recorded or described, the species of *Diopsiulus* deserve special mention, because this genus is also recorded from West Africa, Ceylon and New Guinea but not from Central America, where the family Stemmatoiulidæ is represented, as far as we know, only by the genus *Stemmatoiulus* Gerv.

Very few Myriopods are yet known from the southern portions of North America and from the other West Indian Islands, so that we cannot speak of the affinities of the Porto Rican Myriopods with relation to the species of the above mentioned countries.

CHILOPODA.

1. **Otocryptops melanostomus** *Newp.*

Porto Rico: Monte Mandios, Utuado.

This species has a wide distribution in tropical America, south to Argentina and in the oriental region from Java to the Philippine Islands.

2. **Newportia ernsti** *Poc.*

Porto Rico: Coamo Springs.

Already known from St. Vincent, Venezuela, Brazil.

3. **Otostigmus caraibicus** *Kraep.*

Porto Rico: Utuado.

This species was described from a specimen collected in St. Thomas and until now has not been recorded from other localities.

4. **Cupipes ? ungulatus** *Mein.*

Culebra.

Only one specimen, wanting the anal legs and therefore not to be certainly identified. Since only the last tergite is marginate it resembles *Cupipes ungulatus* Mein., but differs from it in having unarmed pleura.

5. **Geophilus culebræ** sp. nov.

Female.— Color dull ochre-yellow, maxillipedes pallid rusty with black claw. Body moderately narrowed anteriorly and posteriorly.

Head (Fig. I, 1) of nearly equal length and breadth, narrowed anteriorly. Antennæ of moderate length somewhat attenuated. Prebasal plate covered. Width of basal plate more than twice its length, narrowed anteriorly. Mandibles (Fig. I,

6) with one pectinate lamella as in all other species of *Geophilus*. First maxillæ (Fig. I, 4) with a very short process on the outside of the antepenultimate joint. Second maxillæ with the claw of the palpus moderately long and simple, without hairs. Maxillipedes (Fig. I, 2) reaching the frontal margin of head, unarmed.

First sternum (Fig. I, 2) with a small submedian area of pores; sterna 2–25 with a wide transverse and posterior area of pores, which from sternum 26 begin to be interrupted in the middle, and with slightly wider interruptions continue to the penultimate sternum (Fig. I, 5). Sterna 15–20 (Fig. I, 3) with a transverse triangular anteriorly depressed, rusty area. The sternum of the last pediferous segment (Fig. I, 5) trapezoidal, with legs somewhat longer than those of the preceding segment, and armed with a rather robust claw, subcoxæ with two large partly covered pores.

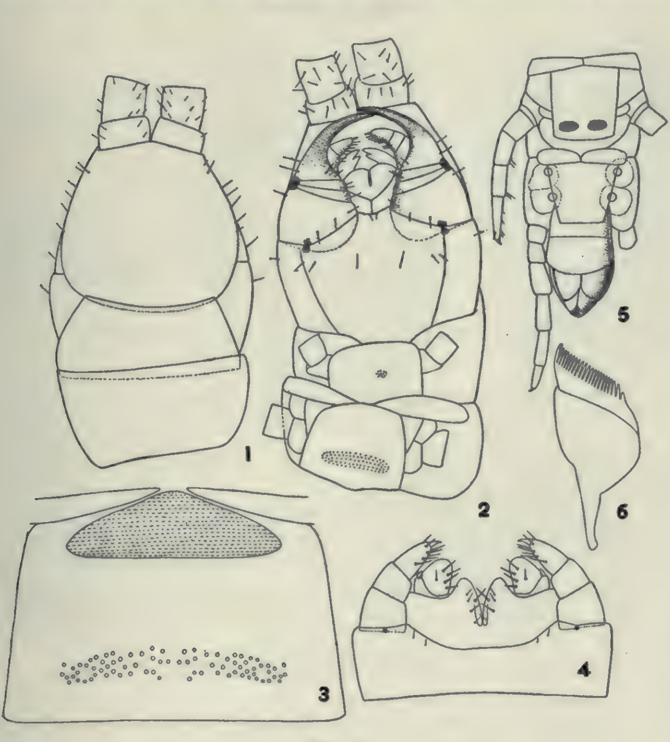


Fig. I.

Geophilus culebræ: 1, head with basis of the antennæ and first two segments from above; 2, head with maxillipides and two segments from below; 3, sternum 15th; 4, first and second maxillae; 5, posterior part of the body from below; 6, mandibula.

Anal pores not detected.

Pairs of legs 60.

Length of body 37 mm.

Habitat.— Cubebra.

This species belongs to the *G. carpophagus* Leach group, but to establish its affinities it is necessary to know better the West Indian Geophiloidea.

DIPLOPODA.

1. **Lophoproctus** sp.

Porto Rico: Utuado.

Only one specimen, wanting antennæ and hairs, and incapable of identification.

2. **Siphonophora portoricensis** *Brandt.*

Siphonophora portoricensis BRANDT, Bull. Acad. St. Petersburg, I (1837), p. 179. — GERVAIS, Apt., IV, p. 209 (1847).— C. KOCH, Die Myriapoden, I, p. 90, fig. 78 (1863).— PETERS, Mon. Ak. Wiss. Berlin, p. 549 (1864).— POCOCK, Journ. Linn. Soc. London, XXIV, p. 478 (1849).

Species briefly described and here simply recorded for Porto Rico.

3. **Diopsiulus compressus** (*Karsch*).

Stemmiulus compressus KARSCH, Zeit. Naturw. (3), VI, p. 11 (1881).— POCOCK, Journ. Linn. Soc. London, p. 478 (1894).

Color brown with median row of light isabelline spots on segments 2–10; on the following segments the spots are contiguous, forming a narrow median stripe with a row of similarly coloured spots along the line of the pores and another row between this and the ventral surface umber in color like the proximal part of the legs.

Body rather robust and compressed, somewhat narrowed anteriorly and much more posteriorly.

Head almost smooth, with a few rather long facial hairs.

Ocelli two, the superior much the larger.

Antennæ elongated, the second joint the longest, joints 3–5 subequal in length, the sixth ⅓ shorter than the preceding and a little thicker at the tip.

Collum quite convex, nearly smooth; the anterior border arched; the sides with three small carinæ, the outer submarginal.

Following segments with a median sulcus and deep longitudinal striæ, which on the submedian surface of the segments are oblique, diverging posteriorly. No setæ on the dorsal surface of the specimens examined. Repugnatorial pores subdorsal in position and somewhat behind the suture.

Preanal segment with posterior dorsal margin convex, slightly projecting beyond the anal valves, and furnished below on each side with six setiferous, conical processes. Base of preanal scale wider than long, subtrapezoidal with two long submedian setæ.

Anal valves slightly convex, moderately hirsute, with internal margin somewhat elevated.

Legs (Fig. II, 6) slender, moderately long, hirsute.

Number of segments 45.

Length 27 mm., width of 15th segment 2.2 mm.; dorso-ventral diameter of same segment 2.6 mm.; length of antennæ 3 mm.

Male.— Body somewhat more slender than that of the female.

Hypostoma (Fig. II, 1) with the internal maxillary stipites longer than in female.

First pair of legs (Fig. II, 2) well-developed, 7-jointed, but joints 1–2 very closely united; joints 3–5 (especially 4–5) internal with long, robust, pubescent, somewhat clavate setæ (Fig. II, 3); sixth joint with an internal row of short setæ and others scattered dorsally and laterally; last joint or claw rather short.

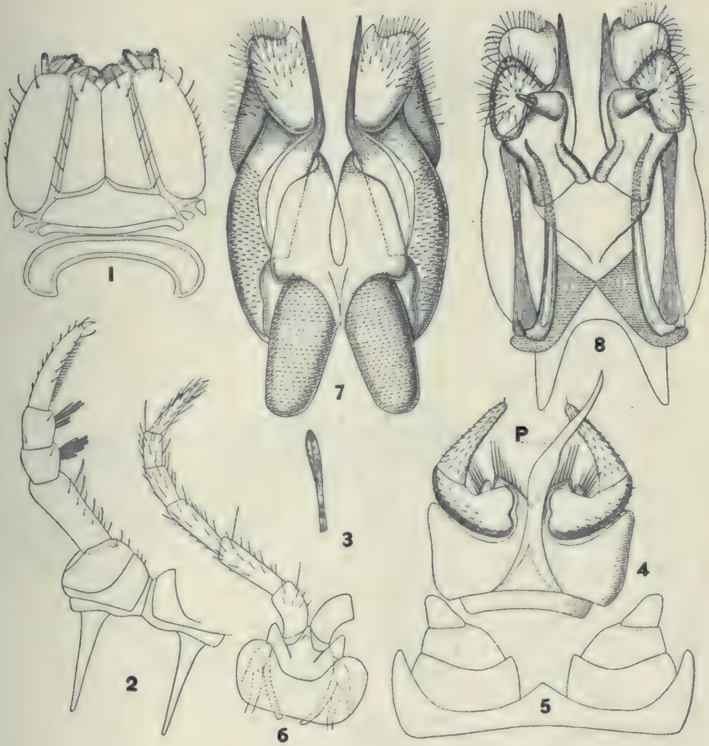


Fig. II.

Diopsiulus compressus male: 1, hypostoma; 2, first pair of legs; 3, seta of third segment of the same legs; 4, second pair of legs, *P*, penis; 5, second copulatory legs; 6, legs of 10th segment; 7 anterior view and 8 posterior view of the first copulatory legs.

Second pair of legs much reduced (Fig. II, 4), 3-jointed, as shown in figure.

Third pair of legs long, moderately crassate, with very small claw and three long, robust setæ at the apex of sixth joint.

First copulatory legs as in Fig. II, 7–8.

Second copulatory legs (Fig. II, 5) very small, 3-jointed.

Penis (Fig. II, 4, P) long, slender, tapering.

The redescription of this species is based on 2 ♀ and 1 ♂ specimens collected by Professor Wheeler at Utuado, Porto Rico.

4. **Diopsiulus wheeleri** sp. nov.

This species is very closely allied to the preceding but may be easily recognized by the following characters:

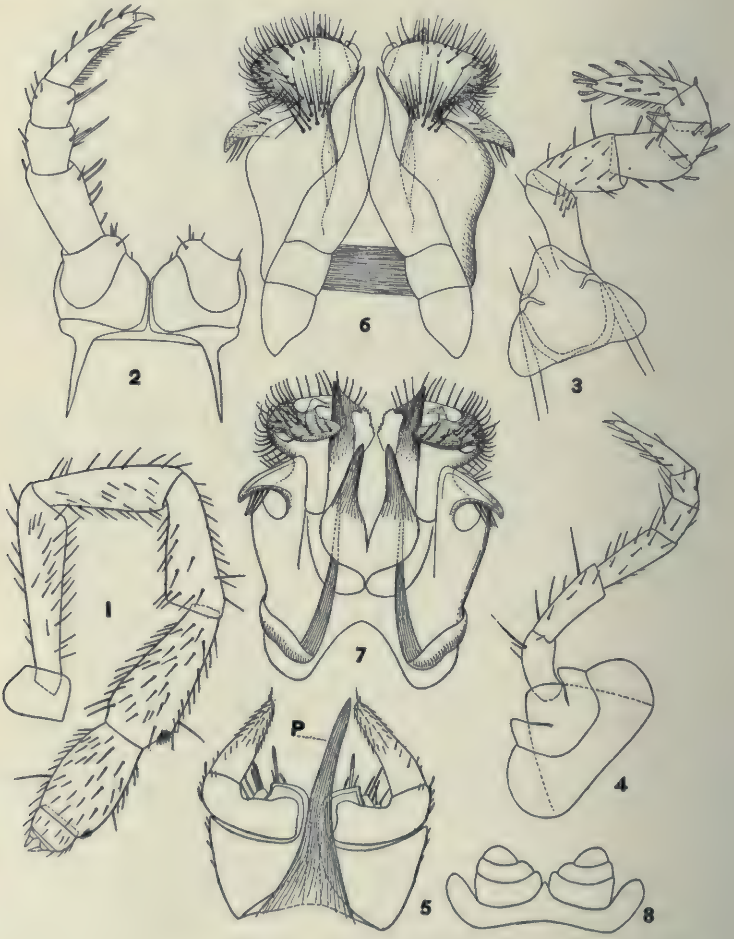


Fig. III.

Diopsiulus wheeleri, male: 1, antenna; 2, first pair of legs; 3, third pair of legs; 4, 10th pair of legs; 5, second pair of legs, *P*, penis; 6, anterior and 7 posterior view of the first copulatory legs; 8, second copulatory legs.

Body small, little compressed but narrowed anteriorly and posteriorly as in *D. compressus* (Karsch).

Color brown with a median isabelline stripe and a row of not very distinct spots along the line of the repugnatorial pores.

Head and antennæ (Fig. III, 1) similar to that of *D. compressus*, but the sixth joint of the latter is less than ⅓ shorter than the fifth.

Legs (Fig. III, 4) more slender and slightly less hirsute.

Male.— First pair of legs (Fig. III, 2) with the internal part of joints 4–5 with two long, robust setæ.

Second pair of legs (Fig. III, 5) similar to that of *D. compressus*.

Third pair of legs (Fig. III, 3) well-developed, with very small claw and the other joints furnished with setæ as in the figure.

First copulatory legs rather different from those of *D. compressus* (see figures III, 6–7).

Second copulatory legs (Fig. III, 8) with the third joint shorter and less slender than in *D. compressus*.

Number of segments perhaps 35–38 (the type specimens are broken).

Length 12–15 mm., width of 15th segment, 1.3 mm.

Habitat.— Culebra.

This species is named after Prof. W. M. Wheeler, by whom it was collected.

5. **Rhinocricus arboreus** (*Sauss.*).

Julus arboreus Sauss., Linn. Ent., XIII, p. 331 (1859).— Mém. Mex. Myr., p. 98, pl. iv, fig. 28 (1860).

Spirobolus (*Rhinocricus*) *arboreus* Karsch, Zeit. Naturwiss. (3), VI, p. 8 (1881).

Rhinocricus arboreus Pocock, Journ. Linn. Soc., XXIV, p. 493, pl. xxxviii, fig. 4.

This species is recorded from the Antilles (St. Thomas), by Saussure, from Porto Rico by Karsch, and from St. Thomas, Santa Cruz and Antigua by Pocock.

Professor Wheeler collected specimens in Culebra, the females of which have 51–54 segments, the males 50–53, and the immature females 50.

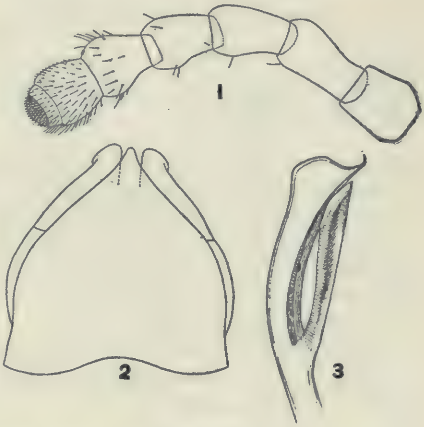


Fig. IV.

Rhinocricus arboreus gundlachi: 1, antenna, 2, anterior view of copulatory apparatus; 3, apex of the internal part of copulatory apparatus.

6. **Rhinocricus arboreus** (*Sauss.*) var. **gundlachi** *Karsch.*

Karsch, Zeit. Naturw. (3), VI, p. 8; Pocock, Journ. Linn. Soc., XXIV, p. 494.

Several specimens of this very distinct variety of *R. arboreus* were collected by Professor Wheeler in Porto Rico: Vega Baja.

Karsch described this variety from Porto Rican specimens.

For the shape of the antennæ and the copulatory legs see Figure IV, 1–3.

7. **Rhinocricus modestior** sp. nov.

Male.— Color dark brown, with the posterior part of all the segments and the anterior portion of the collum brick-coloured; antennæ and legs dark brown.

Head smooth, the vertex with a median sulcus, which is produced anteriorly over the frontal area and terminates on the clypeus where it is deeper. Clypeus with 2+2 setiferous pores.

Antennæ (Fig. V, 1) short, gradually becoming a little crassate to the sixth joint, which is the widest of all; the last joint with many olfactory cones. Eyes nearly round, consisting of about 45 ocelli arranged in 7–8 transverse series.

Collum smooth, rather rounded at the sides with a marginal sulcus.

The following segments with the posterior part smooth, distinctly higher than the rest and separated by a narrow, deep sulcus, the anterior part lightly and irregularly striate. Pores conspicuous just in front of the transverse sulcus. Scobina present, at least in segments 7–28. Preanal segment triangular posteriorly, with moderately rounded tip, crassate and projecting very slightly beyond the anal valves.

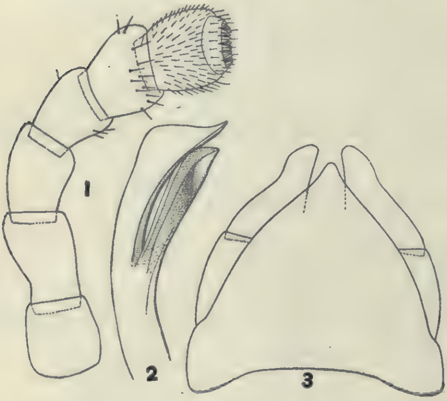


Fig. V.

Rhinocricus modestior: 1, antenna; 2, apex of the internal part of copulatory apparatus, 3, anterior view of copulatory apparatus.

Preanal scale subtriangular.

Anal valves moderately convex with the margin compressed.

Legs 1–3 a little crassate, but with the joints not especially produced. The other legs rather short and slender.

Copulatory legs, see figures V, 2–3.

Number of segments 50.

Length 48 mm., width 4.6 mm.

Habitat.— Porto Rico: Coamo Springs (1 immature male and 1 very young specimen, with 43 segments).

8. **Rhinocricus parcus** *Karsch.*

Spirobolus (*Rhinocricus*) *parcus* Karsch, Zeit. Naturw. (3), VI, p. 68.
Rhinocricus parcus Pocock, Journ. Linn. Soc., XXIV, p. 494.

This species is known from the description given by Karsch and only from Porto Rico.

9. **Spirobolus multiporus** *Karsch.*

Karsch, Zeit. Naturw. (3), VI, p. 58; Pocock, Journ. Linn. Soc., XXIV, p. 485.

This species was also recorded by Karsch for Porto Rico only.

It is very probably congeneric with the following species.

10. **Microspirobolus marmoratus** sp. nov.

Female.— Body lightly isabelline with a dorso-median black stripe and the sides more or less variegated with black which usually predominates over the isabelline; preanal segment black; antennæ and legs light isabelline. Subcylindrical, slightly narrowed posteriorly.

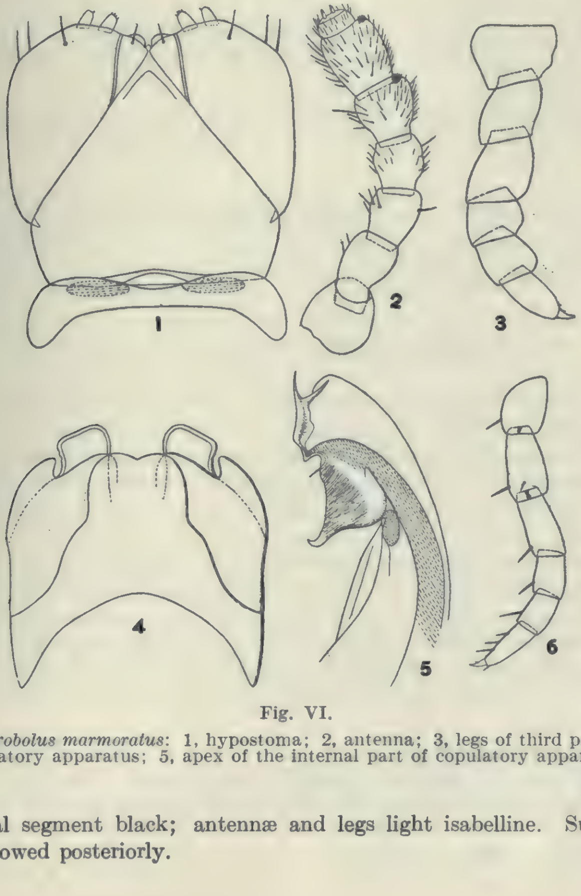


Fig. VI.

Microspirobolus marmoratus: 1, hypostoma; 2, antenna; 3, legs of third pair; 4, anterior view of copulatory apparatus; 5, apex of the internal part of copulatory apparatus; 6, leg of 10th pair.

Head smooth, vertex with faint sulcus, clypeus with 3 + 3 setiferous points. Eyes small, nearly round, consisting of about 22 not very distinct ocelli. Antennæ (Fig. VI, 2) short, gradually crassate as far as the sixth joint, fitting in a cavity of the mandibles.

Hypostoma (Fig. VI, 1) with the infrabasilare consisting of two small, elliptical, widely separated plates covered by the basilare.

Collum smooth with the lateral margin reaching the inferior side of the second segment, rather wide with obtuse rounded angles and a marginal sulcus, which is prolonged also on the anterior margin to just behind the eyes.

The following segments are smooth with a weak transverse sulcus, the posterior part a little higher than the anterior and longitudinally striate ventrally.

Sterna transversely striate. Repugnatorial pores very small, opening a little behind the transverse sulcus.

Preanal segment dorsally triangular, rather pointed, slightly projecting beyond the anal valves. Preanal scale wide, subsemielliptical.

Anal valves convex with margins compressed.

Legs (Fig. VI, 6) short.

Number of segments 37–38.

Length 21 mm., width 2.6 mm., length of antennæ 1.5 mm

♀ Body more slender and legs longer than in the female.

Legs 1–3 (Fig. VI, 3) somewhat crassate.

Copulatory legs, see figures VI, 4–5.

Habitat.— A few specimens collected at Utuado (Porto Rico), by Professor Wheeler.

This species is easily distinguishable from *Spirobolus multiporus* Karsch, at least in color, and is referred by me to the genus *Microspirobolus*, of which I described one species from Venezuela.

11. **Microspirobolus insularis** sp. nov.

Female.— Color blackish with the antennæ and legs pale brick-color.

Head smooth as in preceding species.

Collum smooth or with 2–3 short striæ on the lateral posterior part, sides rather narrowed, more so than in the preceding species, with the anterior angle more or less acutely rounded and the posterior more or less obtusely rounded, provided laterally and antero-laterally with a marginal sulcus.

The following segments smooth with the suture longitudinally striate, especially laterally, the posterior part of the segments a little higher than the anterior part and ventro-longitudinally striate. Repugnatorial pores very small as in *M. marmoratus.*

Preanal segment gradually a little narrowed dorsally, subrounded posteriorly, not projecting beyond the anal valves. Preanal scale wide, short, rounded posteriorly.

Legs rather short.

Number of segments 48–49.

Length 30 mm., width 2.7 mm.; length of the antennæ 1.7 mm.

Male.— Copulatory legs very similar to those of *M. marmoratus* (see Fig. VII, 1–2).

Habitat.— Porto Rico: Utuado.

This species is closely related to the preceding, but is very easily recognized by color, number and sculpture of segments, and form of the preanal segment.

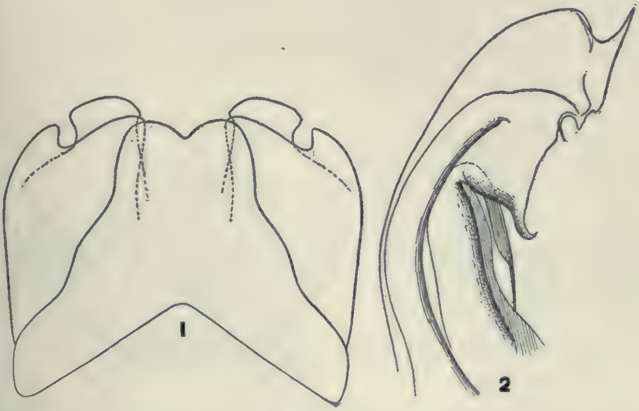


Fig. VII.

Microspirobolus insularis: 1, anterior view of copulatory apparatus; 2, apex of the internal part of copulatory apparatus.

12. **Orthoporus sculpturatus** (*Karsch*).

Spirostreptus sculpturatus Karsch, Zeit. Naturw. (3), VI, p. 39 (1881).— Pocock, Journ. Linn. Soc. London, XXIV, p. 482 (1894).

Female.— Color brown with the extreme posterior part of segments light brown; antennæ and legs light brick-color, in other specimens the body color is subrufous, with the ventral part, antennæ and legs rufous-umber.

Head smooth with a faint sulcus on the vertex and four setiferous points on the clypeus. Eyes wider than long, separated by a space greater than their transverse diameter, consisting of about 36 ocelli arranged in five transverse rows. Antennæ (Fig. VIII, 3), when reversed, reaching a little beyond the collum, gradually very little crassate.

Hypostoma; see Figure VII, 1.

Collum smooth, with the sides a little narrowed, furnished near the lateral margin with two deep sulci, anterior angle obtusely rounded, posterior angle subrectangular, more or less rounded.

The following segments with the prozonæ nearly smooth, the metazonæ all rather deeply and finely wrinkled longitudinally, ventrally longitudinally striate. Suture crenulated. Repugnatorial pores very small, somewhat behind the suture. Sterna smooth.

Legs very short.

Preanal segment nearly smooth or very little wrinkled, dorsal surface wide posteriorly, rounded, not projecting beyond the anal valves. Preanal scale wide and very short.

Anal valves convex with very narrow margins.

Number of segments as many as 58.

Length 60 mm., width 4.5 mm., length of the antennæ 3. mm.

Male.— Collum as in the female.

Legs (Fig. VIII, 4) with 4th–5th joints furnished with a rather small pad.

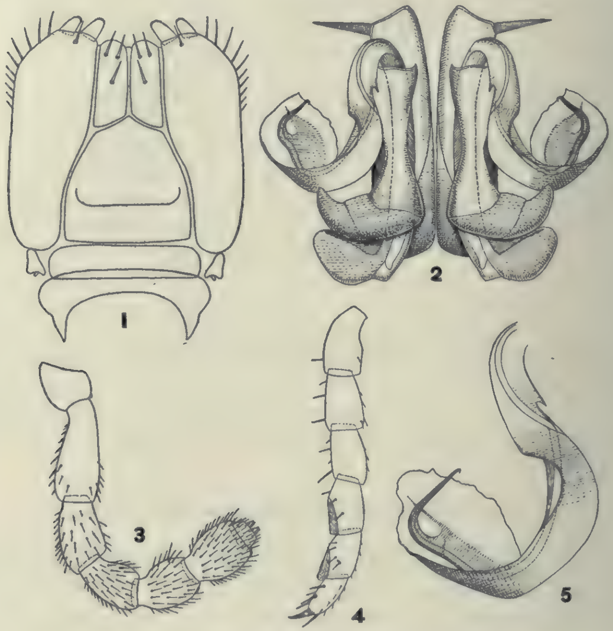


Fig. VIII.

Orthoporus sculpturatus: 1, hypostoma, 2, anterior view of copulatory apparatus; 3, antenna; 4, leg of 10th pair; 5, apex of anterior-internal part of copulatory apparatus.

Copulatory legs, see Figure VIII, 2 and 5.

Habitat.— My redescription is founded on specimens collected by Professor Wheeler in Porto Rico, Utuado, Santurce and near Aibonito, south side of Sierra. The specimens described by Karsch were also from Porto Rico.

13. **Iulus curiosus** *Karsch.*

Iulus curiosus Karsch, Zeit. Naturw. (3), VI, p. 15 (1881).
Paraiulus curiosus Bollman, Bull. U. S. Nat. Mus., 46, p. 61 (1893).
Iulus curiosus Pocock, Journ. Linn. Soc. London, XXIV, p. 480 (1894).

Porto Rico.

Until a new examination of the type specimens is made, it is impossible to establish the right generic position of this and of the following species.

14. **Iulus cæsar** *Karsch.*

Iulus cæsar KARSCH, Zeit. Naturw. (3), VI, p. 18.
Paraiulus cæsar BOLLMAN, Bull. U. S. Nat. Mus., 46, p. 61.
Iulus cæsar POCOCK, Journ. Linn. Soc. London, XXIV, p. 480 (1894).

Porto Rico.

15. **Orthomorpha coarctata** (*Sauss.*).

Prof. Wheeler collected specimens of this widely distributed tropical species in Porto Rico: Utuado, Coamo Springs, Morro at San Juan.

16. **Leptodesmus sallei** (*Sauss.*).

Polydesmus sallei SAUSS., Myr. Mexique, p. 42, pl. ii, fig. 8 (1860).
Odontopeltis sallei POCOCK, Journ. Linn. Soc., XXIV, p. 512 (1894).
Leptodesmus sallei ATTEMS, Denk. Ak. Wien, LXVII, p. 388 (1899).

Some specimens of this species were secured by Professor Wheeler at Utuado and Monte Mandios in Porto Rico.

Saussure recorded the species from the Antilles and Pocock from San Domingo and Hayti.

17. **Leptodesmus mauritii** *Brandt.*

Polydesmus mauritii BRANDT, Bull. Sci. St. Petersbourg, V, p. 311 (1839).
Oxyurus mauritii PETERS, Monats. Ak. Wiss. Berlin, 1864, p. 533.
Odontopeltis mauritii POCOCK, Journ. Linn. Soc. London, XXIV, p. 513 (1894).

Of this species we know only the short description given by Brandt, from which it appears that it is different from *L. sallei*, at least in coloration.

Porto Rico.

Lasiodesmus gen. nov.

Body slender, subcylindrical, composed of the head, collum, anal valves and 19 segments.

Head not covered.

Antennæ (Fig. IX, 1) short, with the 6th joint longer and more crassate than the other, the 5th and 6th joints each with a lateral fine brush of olfactory cones.

Collum (Fig. IX, 2) small, convex, subelliptical, covered with many tubercles, each of which bears a rather long seta.

The following segments (Fig. IX, 2–4) cylindrical and have the metazonæ somewhat higher than the prezonæ, and covered on the dorsal part with as many setiferous tubercles as the collum; they are destitute of lateral carinæ and the inferior part of the metazonæ is only a little lower than the dorsal and without setiferous tubercles, or nearly so.

Repugnatorial pores (Fig. IX, 3) are rather conspicuous and located on the lateral subposterior part of the metazonæ of the segments 5, 7, 9, 10, 13, 15–19.

Sterna very small and somewhat produced at the bases of the legs.

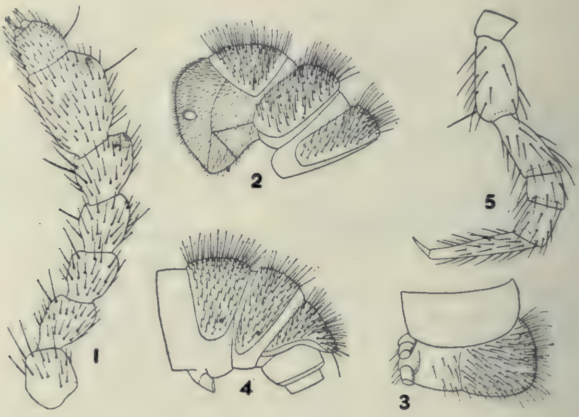


Fig. IX.

Lasiodesmus caraibicus: 1, antenna, 2, head, collum and first two segments; 3, 10th segment; 4, posterior part of body; 5, leg of 10th segment.

Legs (Fig. IX, 5) rather short with the second joint a little longer than the third and furnished beneath at the apex with a long seta; claw simple and rather robust.

Segmentum preanal (Fig. IX, 4) furnished with setiferous tubercles as in the preceding, dorsally triangular at the apex, subcylindrical, projecting beyond the anal valves when closed and not when opened as in Figure IX, 4.

Male unknown.

This genus at first sight is similar to *Cylindrodesmus* Pocock, except for the form of the antennæ. The armature of the metazonæ is easily recognizable as distinct.

18. **Lasiodesmus caraibicus** sp. nov.

Female.— Body brick-colored with the ventral part and the legs umber.

Head (Fig. IX, 2) bearing a great number of short hairs.

Antennæ (Fig. IX, 1) short, with joints 2–4 about equal in length and in width, the 5th very little longer than the 4th, but somewhat wider, the 6th longer and wider as in Fig. IX, 1.

Preanal scale subtrapezoidal with posterior margin a little sinuated and the angles bearing a long seta.

For the other characters see the description of the genus.

Habitat.— A single female specimen from Utuado (Porto Rico).

19. **Tridesmus sectilis** *O. F. Cook.*

O. F. Cook, in the description of the genus *Tridesmus* (*Brandtia*, p. 21), gives this as the type species, but he has not yet published the description of it.

20. **Tridesmus portoricensis** sp. nov.

Female.— Color umber with the antennæ whitish from the second joint.

Head nearly smooth with a sulcus on the vertex. Antennæ rather long, with the joints as in figure X, 1.

Collum (Fig. XI) wide anteriorly and laterally projecting beyond the head, anterior margin widely rounded and divided by sulci into 12 distinct areas, posterior part laterally somewhat obliquely truncate, and in the middle slightly truncate, besides the marginal areas the surface is divided into ten others, each a little elevated in the middle, being furnished with a small tubercle.

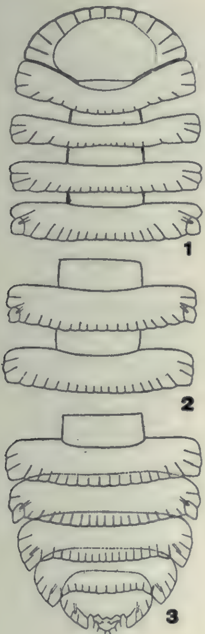


Fig. X.

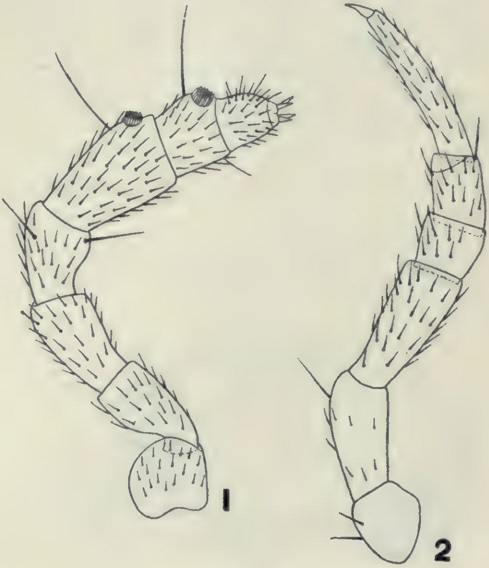


Fig. XI.

Tridesmus portoricensis.

Fig. X.

1, antenna, 2, leg of 10th segment.

Fig. XI.

1 anterior part of body; 2, 10th and 11th segments; 3, posterior part of body (in the figure the sculpture of the body is not reproduced).

The following segments (Fig. XI) with the posterior part divided into 16 areas, the lateral margin of non-poriferous carinæ with 3 areas, the rest of the dorsal surface has four median, transverse tubercles, the anterior of which are little wider than the posterior and at the sides of these there are two other small tubercles and another latero-anteriorly. The carinæ are wider than half the width of the segments, subrectangular, with the anterior angle more or less rounded, the posterior part of the poriferous carinæ of the anterior segments slightly produced, and on the posterior segments gradually becoming more acutely produced; the lateral margin of the carinæ is slightly three-lobed, on the poriferous carinæ of the fifth segment two-lobed, on the others to the 15th, three-lobed, and from the 16th to the 18th four-lobed. Repugnatorial pores open rather far from the margin on the posterior lateral area.

Preanal segment (Fig. XI) very short, subrounded posteriorly and scarcely projecting beyond the posterior angles of the 18th segment. Preanal scale subtriangular with two posterior submedian setiferous tubercles.

Sterna small, smooth, somewhat produced at the base of the legs.

Legs (Fig. X, 2) scarcely projecting beyond the lateral margin of the carinæ with the 2d and 3d joints subequal in length.

Length 8.5 mm., width 2.1 mm., length of the antennæ 1.2 mm.

Habitat.— The above description is based upon a female specimen having 19 segments including the collum, collected at Utuado (Porto Rico).

59.9:04

Article XXIX.— MAMMALOGICAL NOTES.— I–VI.

By J. A. Allen.

It is thought best to bring together here under a general title various minor notes on mammalogical subjects that are too short to be conveniently issued as separate articles. Those of the present installment are as follows:

I. Concrescence in Premolars of a Bat.
II. Bats from the Island of San Domingo.
III. Note on the Type of the Genus *Sciuropterus*.
IV. Note on the Type Locality of *Rangifer arctica* (Richardson).
V. Northward Extension of Range of Coyotes.
VI. The Generic Name *Galera* Brown.

I. Concrescence in Premolars of a Bat.

In a small collection of bats recently received at the Museum from the vicinity of Merida, Venezuela, are several specimens of *Artibeus quadrivittatus* Peters, one of which has the two upper premolars on each side fused, as shown in the accompanying illustrations. The corresponding teeth in the lower jaw are normal. On the right side of the upper jaw the two premolars are solidly fused at the base, but the cusps are distinct from the cingulum upward. On the left side the fusion extends upward for two thirds the length of the teeth. Normally these two teeth are quite similar in structure except that the first is only about half the size of the second, and are crowded in between the canine and first molar, against which they are closely appressed. In the fused teeth there is nearly the same disparity

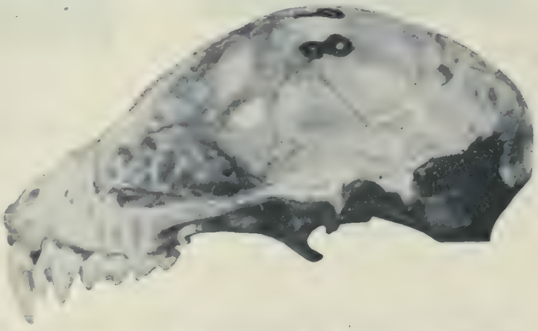


Fig. 1. *Artibeus, quadrivittatus* No. 24398. Outside view of left upper tooth row, showing fused premolars. $\frac{4}{1}$.

in size between the two parts, but the portion representing the first molar rises much higher than in the normal tooth, the two cusps of the fused teeth being of equal height on the right side and nearly so on the left. The accompanying illustrations render further description unnecessary.

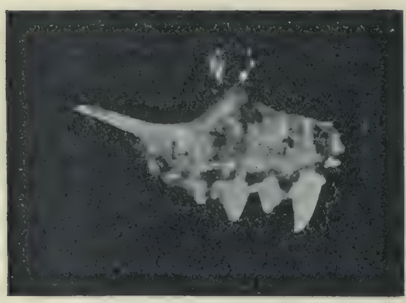


Fig. 2. *Artibeus quadrivittatus*, No. 24381. Outside view of right upper tooth row, normal specimen. $\frac{4}{1}$.

The specimen showing the abnormality is quite young, the milk incisors being still present, but the rest of the teeth were fully developed, except the canines, which had not quite reached their full height. While this anomaly may not have much significance in its bearing upon the 'concrescence theory' of the formation of cusps, it is of considerable interest on account of the extreme rarity of its occurrence.

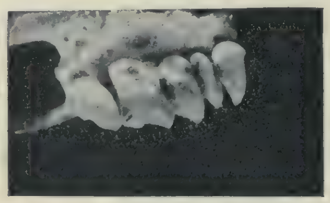


Fig. 3.

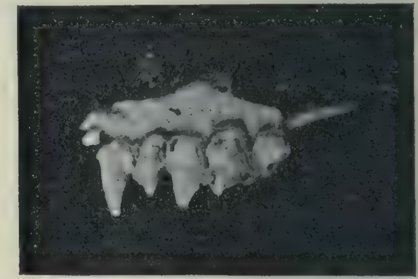


Fig. 4.

Fig. 3. *Artibeus quadrivittatus*, No. 24398. Inside view of left upper tooth row, showing fused premolars. $\frac{4}{1}$.

Fig 4. *Artibeus quadrivittatus*, No. 24381. Inside view of right upper tooth row, normal specimen. $\frac{4}{1}$.

II. Bats from the Island San Domingo.

A small collection of bats, made by Mr. A. H. Verrill in January, 1907, during his expedition to San Domingo in 1906–1907, have been recently acquired by this Museum. They number only six species, but have considerable interest, since little has hitherto been definitely known regarding the bats of San Domingo. Two of the species appear to be undescribed.

The only other mammals obtained by Mr. Verrill on the island are three specimens of *Solenodon paradoxus* (see *antea*, pp. 505–517, pll. xxviii–xxxiii), and a few specimens of the introduced *Mus alexandrinus* I. Geoffroy.

1. **Chilonycteris macleayii fuliginosa** (*Gray*). One specimen, in formalin, Caña Honda, January, 1907.

2. **Otopterus waterhousii** (*Gray*). Nine specimens, skins and skulls, Caña Honda, Jan. 1, 1907.

3. **Artibeus jamaicensis parvipes** *Rehn*. Four specimens, two alcoholic and two skins, Caña Honda, Jan. 8, 1907. Forearm, 52–55 mm.

4. **Ardops haitiensis** sp. nov.

Type, No. 25750, adult, skin and skull. Caña Honda, San Domingo, Jan. 5, 1907; A. H. Verrill.

Smallest of the species of *Ardops* yet known. Forearm, 39 mm., as against 46 and 47 in *A. nichollsi* (Thomas), and *A. luciæ* (Miller), as given by Miller.[1] Total length of skull, 19, as against 20.4 and 23 in *nichollsi* and *luciæ*; maxillary toothrow (c–m^3), 5.5 (7.6 and 6.4); 2d finger, 34 (36 and 41); thumb, 12 (11 and 15.6); 3d finger, 80 (96 and 110); tibia, 15.5 (16.4 and 19). Other measurements, cranial and external, are proportionately small. Known only from the type.

The genus *Ardops* has not previously been reported from outside of the Lesser Antilles, the three previously described species being respectively from Dominica, Montserat, and St. Lucia. The allied genera *Phyllops* and *Ariteus* are known respectively from Cuba and Jamaica, each being represented by a single species.

5. **Nyctinomus brasiliensis musculus** *Gundlach*. Two specimens, one in formalin, and a skin with skull.

6. **Mollossus verrilli** sp. nov.

Type, No. 25764, adult, skin and skull, Samana, San Domingo, Feb. 5, 1907; A. H. Verrill.

Not closely related to any known species, but for convenience of description it may be compared with *M. tropidorhynchus* Gray, of Cuba.

Much larger than *M. tropidorhynchus*, and general coloration darker; forearm, 40 mm. (in *tropidorhynchus*, 34); 3d metacarpal, 41 (in *tropidorhynchus*, 35); thumb stouter and much more curved; feet larger. Skull, total length, 17 (in *tropidorhynchus*, 15); width of brain case, 9 (in *tropidorhynchus*, 8). The skull is more massive, the rostral portion especially more thickened, the brain case more expanded, and the dentition throughout notably heavier; the lower jaw is markedly deeper and heavier, and the canines in both jaws are nearly twice as large as in *tropidorhynchus*.

---

[1] Proc. Acad. Nat. Sci. Phila., 1902, p. 407.

Represented only by the type.

III. NOTE ON THE TYPE OF THE GENUS SCIUROPTERUS.

The genus *Sciuropterus* F. Cuvier was first defined under the vernacular name Sciuroptère by F. Cuvier in 1823 (Mém. du Mus., X, 1823, p. 126), and based on "le sciuroptère assapan (*sciurus volans* Lin.), qui me servira d'objèct de comparaison avec le ptéromys taguan,..." The first use of *Sciuropterus* is by the same author in his 'Dents des Mammifères,' in the 'table methodique,' p. 255, where is given "Sciuroptères, *sciuropterus* F. Cuv. Sciuroptère polatouche, *sciurus volans* Linn."

Regarding the 'assapan' of F. Cuvier, the original type of his *Sciuropterus*, he says ('Hist. Nat. des Mammifères, livr. viii, July 1819): "C'est sous le nom impropre de polatouche que Buffon a parlé de cet animal, originaire de l'Amerique septentrionale, tandis que le polatouche, proprement dit, est du nord de l'ancien continent, et que c'est des Russes qu'il a reçu ce nom, ou plutôt celui de polatouka." This is important, inasmuch as *Sciurus volans* Linn. includes both the assapan and the polatouche, while *Mus volans* Linn., on an earlier page of the same work (*cf.* Syst. Nat., ed. 10, 1758, pp. 85 and 88), relates exclusively to the assapan.

Mr. Oldfield Thomas, in a recent paper entitled 'The Genera and Subgenera of the *Sciuropterus* Group, with descriptions of three new Species' (Ann. and Mag. Nat. Hist. (8), I, pp. 1–8, Jan. 1908) has, with apparently good reason, divided the group into six genera (*Trogopterus* Major, *Sciuropterus* F. Cuv., and *Iomys, Belomys, Pteromyscus* and *Petaurillus*, genn. nov). He has also separated his *Sciuropterus* sens. stric. into four subgenera, of which three are new, namely: *Sciuropterus, Glaucomys, Hylopetes,* and *Petinomys*, and designated a type for each. The type of *Glaucomys* is unfortunately given as "*Sciuropterus* (*Glaucomys*) *volans* (*Mus volans* Linn.)," which is F. Cuvier's "sciuroptere assapan," the monotypic type of his genus Sciuroptère (later his *Sciuropterus*).

Sciurus volans Linn. was, as said above, composite; although based primarily on No. 22, Fauna Suec. (1746), which relates exclusively to the European flying squirrel ("Habitat in Finlandia & Lapponia"), it also included the North American flying squirrels as described and figured by

Catesby and Edwards. Previous to 1908, the type of *Sciuropterus* had repeatedly been given as *Sciurus volans* Linn. (Allen, N. Am. Rodentia, 1877, p. 653; Palmer, Index Gen. Mamm., 1904, p. 625), which was also the only species mentioned where the Latin form of the name was first used. If we go back, however, to the original institution of the genus it is evident that only the assapan (*Mus volans* Linn.) was considered. In dividing the genus *Sciuropterus* into subgenera this fact might well have been recognized, and *Mus volans* Linn. taken as the type, leaving *Sciurus volans* Linn. part (= *Pteromys russicus* Tiedemann) as the type of the palæarctic section of the genus. Under all of the circumstances, however, it may possibly be conceded that it was within the rights of the first reviser (in this case Mr. Thomas) to select *Mus volans* Linn. as the type of his new subgenus *Glaucomys*, and *Pteromys russicus* Tiedemann as the type of *Sciuropterus*, although it would have better expressed the historical facts in the case if this designation of types for the two groups by the first reviser had been reversed.

In determining the type of a genus where a previously designated type is a composite species, it is proper, not to say important, to ascertain which element of the composite was employed by the founder as the principal or sole basis, as the case may be, of his genus.

IV.— Note on the Type Locality of Rangifer arctica (Richardson).

Richardson gave no definite type locality for his "*Cervus tarandus*, var. *arctica*," but in his 'Introduction' to the 'Fauna Boreali-Americana' (I, p. xxv), where the name is first used, he included it in his list of "quadrupeds known to inhabit the Barren-grounds." The region mentioned by him as the Barren-grounds is defined (*l. c.*, p. xxiii) as "bounded to the westward by the Coppermine River, Great Slave, Athapescow, Wollaston, and Deer Lakes, to the southward by the Churchill or Missinippi River, and to the northward and eastward by the sea." This region is joined on the westward and southward by his "Eastern district,"to which he assigns his *Cervus tarandus*, var. *sylvestris*.

His personal acquaintance with the Barren-ground Caribou (his var. *arctica*) appears to have been made first, and mainly, in the Coppermine River country, during his journey down to the Coppermine, along the coast of Coronation Gulf, and on the return trip across country to Fort Enterprise, considerably south of the southern boundary of the Barren-grounds. He says (*l. c.*, p. 250) of the Woodland Caribou (his var. *sylvestris*), "of this variety I know little"; but of the Barren-ground Caribou (*l. c.*, p. 242), that it resorts "to the coast of the Arctic Sea, in summer," and retires "in winter to the woods lying between the sixty-third and sixty-sixth degree of latitude." He gives wood-cuts (*l. c.*, p. 240), "made from drawings by Captain Back, of the antlers of two old buck caribou, killed on the Barren Grounds in the neighborhood of Fort Enterprise." Hence it is necessary to consider Fort Enterprise, in the winter range of the Barren Ground Caribou, as the type locality of this form. He says, however, that Captain Parry saw them on Melville Peninsula, and further states that on the coast of Hudson Bay none go to the southward of Churchill; but, as said above, his personal acquaintance with the animal relates to Fort Enterprise and to the country to the eastward of the Coppermine River.

V. NORTHWARD EXTENSION OF RANGE OF COYOTES.

The Museum is indebted to Mr. Madison Grant, Secretary of the New York Zoölogical Society, for a specimen — skin and entire skeleton — of a Coyote killed near Whitehorse, on the Alsek River, Alaska, in February, 1907. This is by far the most northern record for any form of coyote.

Mr. Grant informs me that in 1902 he found that coyotes were known to occur near Golden, in eastern British Columbia, where the residents of the vicinity reported their appearance as recent, and as still the subject of comment. Previously the most northern record west of the Rocky Mountains was "the arid interior of British Columbia (Ashcroft, Shuswap)." [1]

East of the Rocky Mountains the former northern limit of distribution of coyotes is the vicinity of the fifty-fifth parallel,[2] or about the northern boundary of the Provinces of Alberta and Saskatchewan. Richardson (*l. c.*) states that in his day the coyote, or prairie wolf, was very abundant on the plains of the Saskatchewan, where, according to recent advices, it is still numerous.[3] Mr. Ernest T. Seton informs me that he found, during his trip to the Barren Grounds in 1907, that it was gradually extending its range to the northward, and was now not uncommon as far north as Little Slave Lake.

As is well known, the coyotes of the northern plains (*Canis latrans* Say and *C. l. pallidus* Merriam) are the largest members of the coyote group, considerably exceeding in size the coyotes found in the region west of the Rocky Mountains in the same latitudes. The Alaskan specimen received from Mr. Grant has no near relationship with the coyotes of the Saskatchewan plains, being not only very much smaller, but quite different in color and in dentition. As would be expected, it is, on the other hand, closely related to *Canis lestes* Merriam, of the trans-Rocky Mountain districts. The present specimen is apparently an old female, and differs from an old female of *C. lestes*, from Shuswap, B. C., in being smaller, and slightly in other characters, and may be separable as a northern form of *lestes*. Although the differences between these two skulls are quite appreciable, it would be rash, in the absence of more material for comparison, to recognize these differences in nomenclature. The subjoined measurements of three female skulls — the Alaska specimen, a female *lestes* from Shuswap, B. C., and one from Maple Creek, Saskatchewan (young female, too young to be fairly comparable with the others, but the only one available) — show the Alaska specimen to be the smallest of the three, and illustrate the wide difference in the size of the teeth between the *lestes* and *latrans* types, as regards not only the length of the premolar-molar series, but of individual teeth.

---

[1] Merriam, Proc. Biol. Soc. Washington, XI, 1897, p. 25.

[2] Richardson, Fauna Bor.-Amer., I, 1829, p. 73.

[3] Early in the present year the Museum received 4 specimens, skins and skulls, collected near Maple Creek, Saskatchewan, by E. E. Baynton.

Measurements of Skulls.[1]

	No. 28197 ♀	No. 72876 ♀	No. 28281 ♀
Total length	181	188	190
Condylo-basal length	171	174	181
Basal length	161	167	170
Basilar length	159	162	166
Palatal length	86.3	86.3	—
Interorbital breadth	31	33	30
Postorbital breadth	31	33	31
Zygomatic breadth	91	97	90
Mastoid breadth	54	56	61
Length of upper premolar-molar series	63	67	71.3
Length of p^4-m^2	34	35	38.5
Length of upper carnassial	20	19	20
Length of lower premolar-molar series	74	74	80
Length of m_1-m_3	33.5	34	37
Length of m_1	20	20.5	23

The Alaska specimen is much darker than Saskatchewan specimens, and less fulvous; but the ears, nose, and anterior surface of the limbs are much more rufous, as in the *lestes* type. Compared with a *lestes* specimen of the same sex (♀) from southern British Columbia, the carnassial is slightly longer and heavier, or about like the corresponding tooth of a male *lestes* skull from southern Oregon. The bullæ in the Alaska specimen are smaller, narrower, more elongate and less swollen than in the *lestes* specimens. These slight differences may, however, be individual rather than racial, a point to be determined by examination of additional Alaska specimens.

---

[1] 1. Am. Mus. No. 28197, ♀, Alsek River, Alaska; Madison Grant.
2. U. S. Nat. No. 72876, ♀, Shuswap, B. C.; Biological Survey.
3. Am. Mus. No. 28281, ♀, Maple Creek, Saskatchewan; E. E. Baynton. This is a quite young specimen, as shown by the absence of ankylosis and the rudimentary condition of the sagittal and occipital crests. While not full grown as regards the size of the skull, the dentition is fully developed.

There is apparently no insuperable barrier to their continuous range, through the valleys trending north and south, from the plains of British Columbia northward, west of the main Rockies, but if coyotes inhabit this region they must be rare or of local occurrence, since none have previously been received from any part of this district, which, however, is faunally not yet well known.

In conclusion I desire to acknowledge my indebtedness to Dr. C. Hart Merriam, Chief of the Biological Survey, for the loan of the skulls of *C. lestes* on which the above comparisons are based.

VI. The Generic Name Galera Browne.

The first modern use of *Galera* as a generic name was by J. E. Gray in 1843 (List of Spec. Mamm. Brit. Mus., 1843, pp. xx and 67). He ascribed the name to Browne (*l. c.*, p. xx), and referred to it the single species *Mustela barbara* Linn., citing under it *Galera subfusca* Brown, Jam. t. 29 [*sic*], f. 1" (*l. c.*, p. 67), although Browne was not a binomialist and did not use *subfusca* as a specific name. Thomas, in 1901 (Ann. and Mag. Nat. Hist. (7), VII, Feb. 1901, p. 180, footnote), recognizing the propriety of separating generically the Grisons from the Tayras (following Nehring), adopted "Gray's genus *Galera*" for the latter.

Galera was again brought to notice by Sherborne in 1902, in his 'Index Animalium' (p. 408), where he cites "*Galera* P. Browne, Hist. Jamaica, ed. 2, 1789, 485." It was also included by Palmer, in 1904, in his 'Index Generum Mammalium' (p. 289), where he gives "*Galera* Browne, 1789. Civil & Nat. Hist. Jamaica, 2d ed., 485, Tab. 49, fig. 1, 1789. ....Type, *Mustela barbara* Linnæus, from Brazil." He quotes from Browne: "This creature [the Guinea Fox][1] is often brought to Jamaica from the coasts of Guinea [Guiana],[1] where it is a native." Here Palmer, perhaps following Gray (as above), makes two erroneous assumptions: (1) that the "Guinea

---

[1] The words in brackets are Palmer's.

Fox" of Browne is the *Mustela barbara* of Linnæus; (2) that the Guinea Fox was brought from Guiana and not from Guinea, as stated by Browne. As will be shown later early authors, from Pennant down, accepted Browne's Guinea as Guinea and not as Guiana.[1] As a further indication that Guinea in Africa was referred to, we find under *Hystrix* (p. 487): "This creature is seldom seen in *Jamaica*; though frequent enough on the coast of *Guinea*, from whence it is sometimes brought there in the *African* ships." It is further to be noted that in referring to animals brought from continental America he nowhere uses any other expression than "the main continent."

On the basis, apparently, of Gray and Palmer, Elliot in 1905 (Check-List of the Mammals of the North American Continent, etc. p. 418) adopted "*Galera* Browne" as the proper generic designation of the Tayra and Grison groups, with "Type *Mustela barbara* Linnæus." In 1907 he (Cat. Coll. Mamm. in Field Columbian Museum, 1907, pp. 442, 443) continued the same use of *Galera*.

The history of the case of *Galera* is as follows: Patrick Browne in his 'Civil and Natural History of Jamaica' (fol., 1756), proposed the name *Galera* (*l. c.*, p. 485), in a generic sense, for an animal he called "the Guinea Fox," of which he gave a rude figure (*l. c.*, pl. 49, fig. 1) and a very brief account. Two editions of this work appeared, the second bearing date 1789, which are textually the same, except that the second has a new title-page, a new map, and "Four additional indexes [unpaged] to Dr. Brown's [*sic*] Natural History of Jamaica."[2] The latter are simply a concordance of the systematic names of the author, of both the plants and animals, and those of Linnæus.

Galera Browne dates from the first edition of his 'History,' which was published two years before the beginning of binomial nomenclature. Its republication in the second edition (1789) was without change, except that to the plate was added "Fig. 1. Mustela barbara?," evidently based on Linnæus's references to Browne in the 10th and 12th editions of his Syst. Nat., as noted below.

Erxleben (Hist. Reg. Anim., 1777, p. 453) identified Browne's "Galera" with the "Vansire" of Madagascar, and with the "Koekeboe" of Guinea

---

[1] Thus Pennant, in his 'Synopsis of Quadrupeds' (1771, p. 225, Nos. 160 and 161), and also later in his 'History of Quadrupeds,' has a "Guinea Weesel" based on Browne's Galera, and a "Guiana Weesel," based on *Mustela barbara* Linnæus.

[2] A collation of the two editions shows that the second differs from the first as follows: (1) a new and considerably altered title-page; (2) a new and greatly improved map of Jamaica, dated 1774; (3) a systematic concordance of Browne's plant and animal names with those of Linnæus, forming 23 unpaged leaves, and entitled as above; (4) the plates are reëngraved (and reversed), and are much more coarsely done than the originals, with sometimes slight omission of details; and in place of the names of the draftsman ("G. D. Ehret delin. 1755") and engravers ("Patton Sculp.," and others, on different plates) are added at the bottom of the plates the technical names of the objects delineated, which were not given on the original plates; (5) the first three signatures of the main text (pp. 1–12) have been reset, with very slight verbal changes, but the pagination is unchanged. The rest of the text consists evidently of "left-over" sheets, utilized for a second edition.

(Rossmann, Reise nach Guinea, 1708, p. 299), employing for the three collectively (and properly, as these three names all refer to the same species) the name *Mustela galera*. Schreber adopted the same name at about the same date. (Schreber and Erxleben cite each other; Schreber gave the page reference to Erxleben, but Erxleben cited only Schreber's plate, which is copied from Browne's.) They both combined with these "le Tayra ou le Galera" of Buffon (Hist. Nat., XV, 1767, pp. 155, 156), doubtless because Buffon believed that the "Galera" or "Guinea Fox" of Browne might be the same as his "la Belette noir du Bresil," which he says is also found in Guiana, where it is called Tayra; and he further conjectured that the name galera is "un mot corrompu & dérivé de tayra"; and also suggests that while the animals described by Browne as the Guinea Fox may have been brought to Jamaica from Africa, that they had been first shipped from Brazil to Guinea and thence to Jamaica. Aside from these conjectures, Buffon's "le Tayra ou le Galera" is also Browne's "Guinea Fox."

Buffon doubtless took his cue from Linnæus, who in 1758 (Syst. Nat., ed. 10, p. 46) described the Tayra, evidently from personal knowledge of the animal, under the name *Mustela barbara*, including as his sole reference: "Confer. Brown. jam. 485. 49. f. 1. Galera?" In the 12th edition he again cites Browne, and again with a mark of interrogation. In this way began a confusion which still prevails, as the sequel to this note will show.

Browne's long Latin diagnosis of *Galera* contains little that is applicable to the Tayra, but much that well agrees with the Mungoose of East Africa, which his figure, though crude, and evidently not *ad nat.*, strongly suggests.[1] Besides, he says: "This creature is often brought to *Jamaica* from the coasts of *Guinea*, where it is a native,....It burrows under ground....It is of the size of a small rabbit or cat, and very strong in its fore-feet, which are much shorter than the hinder." The Tayra, however, is not a native of Guinea; it is not a fossorial, burrowing animal but is arboreal; it is much larger than a "small rabbit or cat"; its color would not be described as "subfuscus," it being black, with the head gray, and with a prominent white or yellowish spot on the foreneck.

Browne's Guinea Fox was correctly identified by Pennant, Schreber, Erxleben and other eighteenth century authors with the "Vondsira" of Flacourt (Hist. de la Grande isle Madagascar, 1661, p. 154; later the Vansire of Buffon) who obtained a specimen in that island, doubtless brought there, as well as to Jamaica, from Africa, but whose true home was later found to be the neighboring coast of Africa (*cf.* Thomas, P. Z. S., 1882, p. 154). As noted above, it was first properly introduced into binomial nomenclature by Erxleben, as *Mustela galera*; it was later (1826) renamed by F. Cuvier *Atilax vansire*, and is now currently known as *Herpestes galera* (Erxl.), the Water Mungoose. If, therefore, *Galera* Browne be tenable from his second edition (1789) it must replace *Herpestes* Illiger, 1811, now used for the Mungooses. In any case it has nothing whatever to do with the Tayras of tropical America. As, however, *Mustela barbara* Linn. has repeatedly been treated as the type of *Galera*, a word on this point seems necessary.

---

[1] The head of the animal appears to have been based on a *Didelphis*, especially the teeth.

Article 30 of the International Code of Zoölogical Nomenclature rules that "Species which were *species inquirendæ* from the standpoint of the author of the generic name at the time of its publication" "are excluded from consideration in sëlecting the types of genera." Therefore the engraved name "*Mustela barbara*?" on plate 49 of the second (1789) edition of Browne's work does not render this species available as the type of *Galera*; nor will the designation of this species as the type of *Galera* by Gray in 1843 avail, in face of the fact that the *Galera* of Browne was a Mungoose and not a Tayra. Therefore *Galera* Gray, 1843 (nec Browne) = *Tayra* Oken, 1816; while *Galera* Browne, 1789 (type *Mustela galera* Erxl.) = *Atilax* F. Cuv. 1826 = *Herpestes* Illiger, 1811.

56.57, 93T (118: 78.8)

Article XXX.— THE TERTIARY TENTHREDINOIDEA OF THE EXPEDITION OF 1908 TO FLORISSANT, COLO.

By S. A. Rohwer.

The saw-flies of the expedition of 1908 to the Florissant Tertiary shales were but seven in number, but they are very interesting. Five of the seven species were new, one of these forming a new genus.

The large *Schizocerus konowi* suggests to the writer a neotropical form, but otherwise the species are very similar to what one would expect in the eastern Atlantic States today. Of the other described ones there is one, *Megaxyela petrefacta* Brues, which resembles closely a *Megaxyela* from Texas. The new genus, *Nortonella,* is probably a mutant from one of the older genera of Tenthredininæ, and would not be characteristic to any region.

Nortonella suggests a possible clue to the origin of that group of Tenthredinoidea which has both recurrent nervures received by the second cubital cell.

With the species described in this paper the fossil saw-flies of Florissant number 30, representing 19 genera. The recent are 31, representing 14 genera.

Schizocerus konowi n. sp.

♀. Length 9.25 mm.; length of anterior wing 6 mm. Head as usual for genus. Middle lobe of mesonotum longer than usual, extending backward much farther than usual, narrowing distinctly posteriorly; the basal half bounded by a broad, rounded ridge, which is crossed transversely by distinct furrows, these furrows are quite close together. Thorax generally rather closely punctured, with medium size punctures. Intercostal cell distinct, broad at apex; stigma large, lower margin quite straight, apex obliquely truncated; basal nervure about half its length basad to origin of cubitus; first recur. received near base of second cub.; second recur. received in basal half of third cub.; third cubital much wider on radial nervure than on cubitus; tran. med. received in middle of first disc.; lanceolate cell very broadly contracted. Lanceolate cell of hind wings shortly petiolate, not as longly so as usual. Color black; abdominal segments 1–4 ferruginous. Basal half of wings hyaline, apical half very dark; venation brown.

Habitat.— Tertiary shales, Florissant, Colo., Station 13B, 1908 (S. A. Rohwer). Type in the University of Colorado.

This species is not related to any described recent one of boreal North America, and is quite different from any modern one known to the writer. The curious sculpture bounding the middle lobe of the mesonotum is very distinctive. Among the described fossil species from Florissant it is nearest to *Lisconeura vexabilis* Brues, but is quite different from that.

The reverse of the type does not show the curious structure of the thorax as well as the type does.

Named in honor of the late Rev. F. W. Konow.

Eriocampa bruesi n. sp.

Probably a ♂. Length 5 mm., length of anterior wing 4.5 mm. Antennæ short, stout, slightly clavate; joints four, five and six equal. Head and thorax closely rather finely granular or punctured. Posterior tarsi longer than their tibiæ; first joint about equal to 2 + 3 or a little longer. Intercostal vein apparently absent; stigma rounded on lower margin; basal nervure joins cubitus at its base; first recur. in basal half of second cub.; second recurrent a little basad of middle of third cub.; second tran. cub. shorter than the first, and much shorter than the third making the third cubital much wider at the apex; second cubital on radius more than twice the length of first cubital on cubitus; tran. med. in basal third of cell; lanceolate cell with the contraction not as strong as usual; cross-nervure of lanceolate cell decidedly oblique. Color dark brown or black; basal two-thirds of abdomen ferruginous; femora and tibiæ except apex rufous; tarsi infuscated. Wings hyaline; venation brown.

Habitat.— Tertiary shales of Florissant, Colo., Station 13B, 1908 (Melford Smith). Type in the University of Colorado.

In the apparent absence of the intercostal nervure this species differs from *Eriocampa.*

Its size will at once separate it from the other members of the genus, but the following table will make their separation certain:

Second cubital on radial no longer than first cubital on cubitus; (wings hyaline; length 9 mm.) . . . . *wheeleri* Ckll.
Second cubital on radial more than twice as long as first cubital on cubitus . 1.
1. Length 9 mm.; abdomen black; wings infuscated; cross-nervure of lanceolate cell not decidedly oblique . . . . *scudderi* Brues.
Length 6 mm.; abdomen at base ferruginous; wings hyaline; cross-nervure of lanceolate cell strongly oblique . . . . *bruesi* Roh.

Nortonella n. gen.

Habitus much as *Tenthredo* and *Macrophya.* Head large, as wide as thorax, deep. Antennæ 9-jointed, filiform, joint three longer than four. Legs and abdomen absent in type. Intercostal vein absent, stigma large; tran. radial nervure bent, received in about middle of third cubital; four cubital cells; second receiving both recurrent nervures, the first a little basad of middle, the second near the apex of the cell; basal nervure more than half of its length basad of origin of cubitus;

lanceolate cell with a short, broad cross-nervure. Hind wing with two discal cells; lanceolate cell petiolate at apex.

Type *Nortonella typica* Roh.

This new genus belongs to *Tenthredininæ* and is probably most closely related to *Macrophya.* It may be known from all its allies by the absence of the intercostal nervure, and second cubital receiving both recurrent nervures.

Nortonella typica n. sp.

Sex ? Length perhaps 10 mm.; length of anterior wing (Fig. 1) about 8.5 mm. Head and thorax closely, finely punctured. Third antennal joint a little longer than fourth; apical joint smaller and shorter than preceding one. Stigma large, rounded on lower margin, drawn out by the transverse radial; tran. med. in basal third of cell; cubitus drawn upward by the first tran. cubitus; radius drawn up by the tran. rad.; basal nervure slightly bent on lower part. Color black. Wings hyaline; venation rather pale brown.

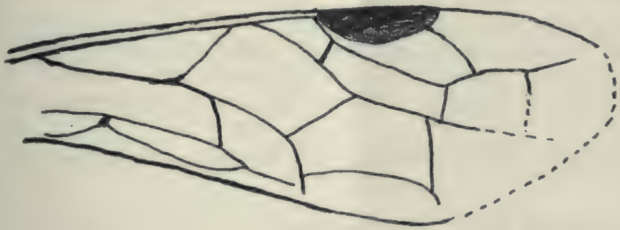


Fig. 1. *Nortonella typica* n. sp. Anterior wing.

Habitat.— Tertiary shales of Florissant, Colo., Station 13 B, 1908. Collector unknown. Type in the University of Colorado.

Of the fossil species of Florissant, Colo., this one is more closely related to *Macrophya pervetusta* Brues, but it is very different from that.

Dineura cockerelli *Roh.*— A specimen and reverse from Station 13 B in the Tertiary shales of Florissant, Colo., 1908 (Geo. N. Rohwer). Differs in being only 7.5 mm. long and in a few other characters.

Dineura fuscipennis n. sp.

Sex ? Length 8 mm.; length of anterior wing 6.5 mm. In general habitus much like *D. cockerelli* Roh. Head rounded, not as wide as thorax. Third antennal joint somewhat longer than fourth; fourth and fifth equal; antennæ extending back as far as the scutellum at least. Middle lobe of mesonotum bounded by a rather sharp ridge. Intercostal nervure its own length beyond basal; stigma rounded on lower margin; tran. rad. in basal third of third cub.; second recurrent received by second cub. about half the length of the second tran. cubitus from apex; tran. med. received a little beyond middle; basal nervure bent inwardly posteriorly; the venation is much like *D. cockerelli* but differs in a few marked particulars. Color black; basal two-thirds of abdomen light. Wings strongly infuscated; venation dark brown.

Habitat.— Tertiary shales of Florissant, Colo., Station 13 B, 1908 (S. A. Rohwer). Type in the University of Colorado.

This species is much like *D. cockerelli* Roh., but the infuscated wings and the decided change in position of intercostal nervure will separate it from that species. This is nearer *Dineura* as now defined than any of the other fossil species of Florissant.

The following table will separate the four species known from Lake Florissant.

Tran. med. received between the middle and base of first discoidal cell; (length 7 mm.) . . . . *saxorum* Ckll.
Tran. med. received at or beyond middle of first discoidal cell . . . . 1.
1. Robust; second recurrent very close to second tran. cubitus *laminarum* Brues.
Slender; second recurrent quite free from second tran. cubitus . . . . 2.
2. Wings hyaline; intercostal vein more than its own length basad of basal *cockerelli* Roh.
Wings strongly dusky; intercostal vein its own length beyond basal *fuscipennis* Roh.

Atocus defessus *Scudd.*— A specimen from Station 13B of the Florissant shales, 1908 (W. P. Cockerell). This specimen confirms the characters given on p. 524, Bull. Am. Mus. Nat. Hist., Vol. XXIV, 1908. Whether *Atocus* is a good genus or not is a question. I think that it should be reduced to a subgenus of *Pamphilus*.

Tenthredo saxorum n. sp.

Probably a ♂. Length 14 mm.; length of anterior wings 11 mm. Rather slender. Head and thorax rather coarsely granulated. Head developed behind eyes; as wide as thorax. Antennæ as usual, reaching to about middle of scutellum, joints not well differentiated. Venation very similar to modern species. Stigma tapering gently to apex; tran. rad. curved, joining third cub. near apex; third cub. twice as wide at apex as at base; second recur. joining third cub. about the length of second tran. cubitus from base; tran. med. in basal third of cell; cross-nervure of lanceolate cell rather short, bring the cell almost together; lanceolate cell of hind wings normal for genus *Tenthredo, i. e.*, not petiolate at apex. Abdomen long as head and thorax; parallel sided. Head and thorax deep black; basal two-thirds of abdomen ferruginous, apex black. Wings hyaline; venation black.

Habitat.— Station 22[1] of Tertiary shales, Florissant, Colo., 1908 (S. A. Rohwer.) Type in the University of Colorado.

---

[1] *Station 22* was established in 1908 on a hillside facing southwest. The hill is southeast of "Fossil Stump Hill," and is where a good deal of the Scudder material came form. The layers worked at station 22 are the same as those worked at Station 17. The expedition is grateful to Mr. Thompson — who in former years collected fossils for Scudder — for showing us Station 22, and other favors.

Of the fossil species of *Tenthredo* this is nearer *T. avia* Brues, than any of the others. It and *T. avia* are the only fossil species which have the lanceolate cell of the hind wings sessile, a character which seems to be constant in the recent species. The other species assigned to the genus *Tenthredo* probably belong to some other of the recent segregates of *Tenthredo. T. saxorum* may be easily known from *T. avia* by the different shape of the lanceolate cell and much darker color.

T. saxorum in color is related to *T. occidentalis* Cress., a recent species found at Florissant, but it is much larger than that species, and is more strongly sculptured.

56.57, 98M

Article XXXI.— A FOSSIL MELLINID WASP.

By S. A. Rohwer.

Mellinus handlirschi n. sp.

Sex ?. Length of head and thorax 4.75 mm.; length of anterior wing 6 mm. Head and thorax black, closely, rather finely punctured. Wings clear hyaline, perhaps iridescent; venation dark brown. Radial cell long and narrow, widest where the second transverse cubital joins it, from whence it tapers to an acute apex. Second cubital cell subquadrate, slightly narrower on the radial nervure. First recurrent received by the first cubital near its apex, but quite free from the first transverse cubitus. Second recurrent nervure received by the third cubital about the same distance from the second transverse cubitus as the first recurrent is from the first transverse cubitus. Submedian cell shorter than the median. Submedian cell of the hind wings distinctly longer than the median.

Habitat.— Station 14 of the Tertiary shales of Florissant, Colo., 1908 (S. A. Rohwer). Type in the museum of the University of Colorado.

In venation this species is almost exactly like the modern *Mellinus rufinodus* Cress. The only difference is that the second cubital cell does not narrow so strongly towards the radial nervure. The sculpture is probably somewhat coarser than in *M. rufinodus.*

This is the first fossil *Mellinus* which has been given a specific name. Brischke (Schr. Nat. Ges. Danzig. n. f. vi, p. 278, 1886) states that there is one in Baltic Amber.

Dedicated to Dr. A. Handlirsch in recognition of his helpful work on Palæoentomology.

56.9,72T(1181)

Article XXXII.— NEW OR LITTLE KNOWN TITANOTHERES FROM THE EOCENE AND OLIGOCENE.

By Henry Fairfield Osborn.

Introduction.

In the preparation of the United States Geological Survey monograph 'The Titanotheres' the collections of Eocene and Oligocene materials in the larger museums of the country have been reviewed with care. Like the Oligocene titanotheres previously reviewed,[1] the Eocene titanotheres prove to be in a high degree polyphyletic. The remarkable collections made by the American Museum expeditions under Messrs. Wortman, Peterson, Matthew, and Granger, throw a flood of light on the phylogenetic and stratigraphic succession. The present bulletin, published with the approval of Director Smith of the U. S. Geological Survey, is a partial synopsis of the new systematic and phylogenetic results which will be set forth fully in the monograph. It has been prepared with the assistance of Mr. W. K. Gregory.

I. Species from the Wind River Formation, Lower Eocene.

Lambdotherium popoagicum Cope.
Eotitanops borealis (Cope).

Lambdotherium popoagicum *Cope.*

(Figs. 1, 2, 3.)

Doubts (Osborn) as to the reference of this animal to the titanotheres have been removed by the careful examination (Gregory) of all the materials known, which proves that it is a very slender-limbed and in certain respects aberrant rather than generalized form. It was adapted to the dry land conditions which prevailed (Loomis) in the region of the deposition of the Lower Wind River beds in northern Wyoming, which at the same time favored other slender-limbed forms, such as *Eohippus* and *Heptodon*. The accompanying figures illustrate the principal characters of the feet and teeth.

---

[1] The Four Phyla of Oligocene Titanotheres. Bull. Amer. Mus. Nat. Hist., Vol. XVI, Feb. 18, 1902, pp. 91–109.

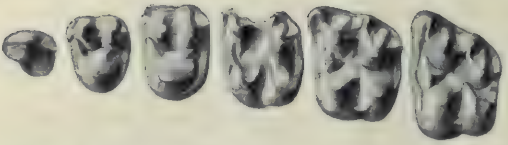


Fig. 1. *Lambdotherium popoagicum* Cope. Upper cheek teeth; composition from different individuals, chiefly No. 4664 Amer. Mus. × ½.

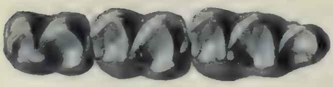


Fig. 2. *Lambdotherium popoagicum*? (type of *L. primævum* Loomis). Inferior true molars. No. 254 Amherst Museum. Courtesy of Prof. F. B. Loomis. × ½.

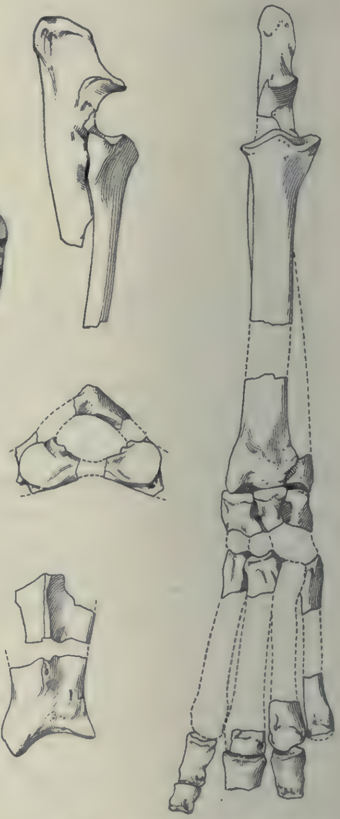


Fig. 3. *Lambdotherium popoagicum*. No. 4880 Amer. Mus. Left radius, ulna and manus, front view; right radius and ulna proximal portion, outer side view; atlas, back view; left scapula, distal portion, outer view. All × ½.

Eotitanops *Osborn.*

Type reference.— Bull. Amer. Mus. Nat. Hist., Vol. XXIII, 1907, p. 242 (type species designated (*Palæosyops borealis* Cope), genus not defined).

Type species.— *Palæosyops borealis* Cope (Fig. 4).

Generic characters.— From Wind River formation (? Lower). Superior molars subquadrate and rounded in form; conules reduced, sub-lophoid; m^1–m^3, 63 mm. (estimated). Inferior molars without metastylids. Hypoconulid of m_3 subconic. First inferior premolar present. Manus tetradactyl, functionally tridactyl with a tendency to mesaxonic structure.

The geological level of this animal is not as yet precisely determined, that is, whether it was contemporary with *Lambdotherium* in the Lower Wind River formation or a sequent form in the Upper Wind River. Cope placed it with the genus *Palæosyops* provisionally; it certainly does not belong to this short and broad-skulled phylum, but rather to one of the long-skulled phyla, possibly *Mesatirhinus*. In this uncertainty and in the presence of characters which distinguish it clearly from both *Lambdotherium* and *Mesatirhinus* it is well to assign this animal a new generic rank, under the name **Eotitanops**.

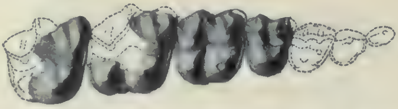


Fig. 4. *Eotitanops borealis* (Cope). Type. P^4–m^3 right. No 4892 Amer. Mus. × ½.

It embraces the species *Eotitanops borealis* (Cope) and *E. brownianus* (Cope).

II. Species from the Lower Bridger Formation, Middle Eocene.

Limnohyops priscus.
Limnohyops matthewi.
Limnohyops monoconus.

1. *First broad-skulled group,* Limnohyops *Marsh and* Palæosyops *Leidy.*

Members of these two phyla evolve contemporaneously and are especially characteristic of the Bridger. While very distinct in some characters they are so closely similar in others that in most previous descriptions they have been extensively confused.

Limnohyops priscus sp. nov.

(Fig. 5).

Type locality.— Grizzly Buttes, Bridger Basin, Wyoming, level B2.

Type.— A crushed skull with excellent dentition, No. 11687, Amer. Mus. discovered by the American Museum expedition of 1903.

Specific Characters.— Level, Bridger B2; p^1–m^3 148 (type) to 161 mm. Distinguished from the contemporary *Limnohyops lævidens* Cope by its larger size and by the more progressive character of pm^2–pm^3. Second superior premolar obliquely elongate with a very rudimentary tritocone. Large hypocone on m^3.

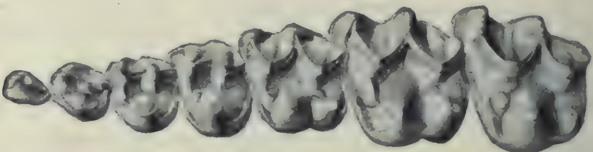


Fig. 5. *Limnohyops priscus.* Type. P^1–m^3 left. No. 11687 Amer. Mus. × ½.

The name refers to the low geological level and primitive characters of this species.

Limnohyops matthewi spec. nov.

(Fig. 6.)

Type locality.— Grizzly Buttes, Bridger Basin, level B2.

Type.— A skull, No. 11684 Amer. Mus., lacking the anterior portion and dentition. Discovered by the American Museum expedition of 1903.

Specific characters.— From level B2 Bridger formation. Intermediate in size between *L. lævidens* and *L. monoconus.* M^3 of small size with large hypocone and quadrate inner half. Occiput very high and narrow. Cranial portion of skull greatly abbreviated, bringing posttympanic and postglenoid processes into broad union. Temporal openings subcircular as defined by zygomatic arches.

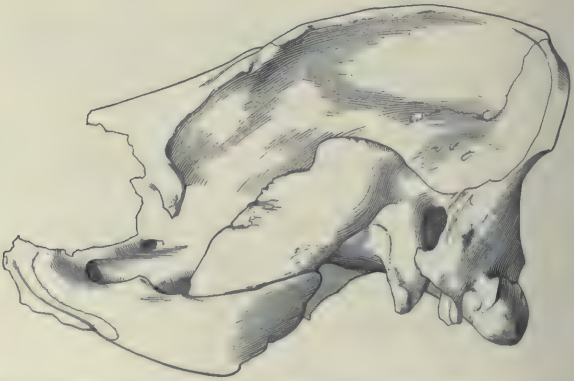


Fig. 6. *Limnohyops matthewi.* Type. No. 11684 Amer. Mus. × ¼.

The species is named in honor of Dr. W. D. Matthew of the American Museum staff.

Limnohyops monoconus spec. nov.

(Fig. 7.)

Type locality.— Grizzly Buttes, Bridger Basin, level B2.

Type.— A crushed skull with dentition, No. 11679 Amer. Mus. Discovered by Mr. Quackenbush of the American Museum Expedition of 1903.

Specific characters.— Recorded from level B2, Bridger. M^3 without hypocone, roundly triangular in form, with broadly extended ectoloph and parastyle. P^2–m^3 150, p^1–m^3 163 mm. Condyle to incisive border 510. Occiput very high, cranium relatively elongated, with space (4 mm). between posttympanic and postglenoid processes. Temporal openings as defined by zygomatic arches elongate.

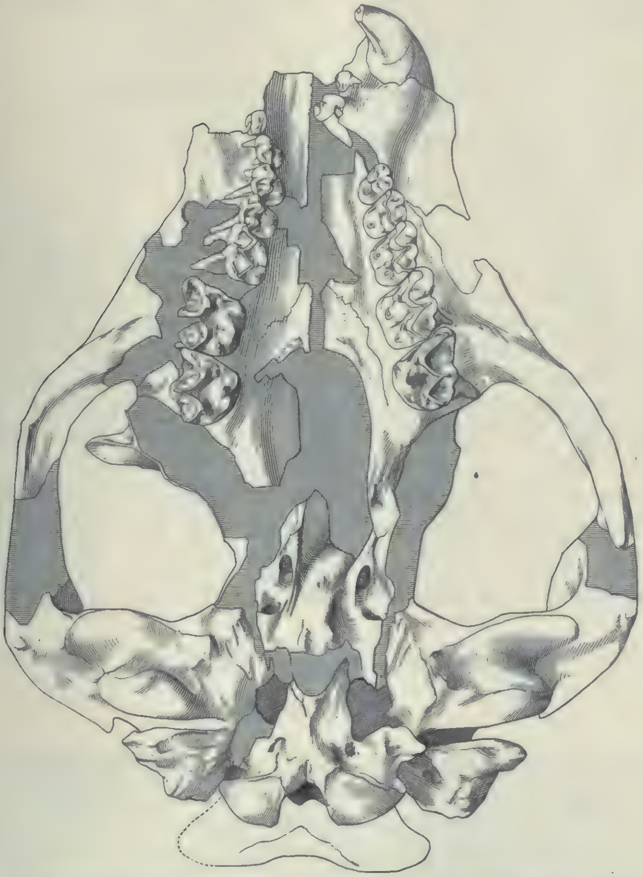


Fig. 7. *Limnohyops monoconus.* Type. Crushed skull, inferior view. No. 11679 Amer. Mus. × ¼.

Named in reference to the presence of but a single cone on the inner side of the third superior molar, an exceptional condition in the genus *Limnohyops.*

III. SPECIES FROM THE UPPER BRIDGER AND LOWER WASHAKIE FORMATIONS, MIDDLE EOCENE.

Palæosyops leidyi.	*Mesatirhinus petersoni.*
Palæosyops grangeri.	*Manteoceras washakiensis.*
Palæosyops copei.	

1. *First broad-skulled group* (continued).

Palæosyops leidyi spec. nov.

(Fig. 8.)

Type locality.— Henry's Fork, Bridger Basin (Wyoming), levels C2–C4.

Type.— A well preserved skull No. 1544 Amer. Mus., associated with considerable portions of the skeleton. This specimen is now mounted in the American Museum, the missing parts having been supplied from other individuals. Discovered by the American Museum expedition of 1893 under Dr. J. L. Wortman.

Specific characters.— From Bridger levels C2–C4. Of larger size; total length of skull 415 mm.; p^2–m^3, 158; p_2–m_3, 168. Diastema behind canine. P^3, p^4 superior with mesostyles. Barely defined swellings representing the rudiments of osseous frontonasal horns.

The species has long been confused with the *Palæosyops major* and *P. paludosus* of Leidy, the types of both of which are from the Lower Bridger, Cottonwood Creek. It is named in honor of Joseph Leidy, the discoverer of the family and of the genera *Palæosyops, Titanotherium* and *Megacerops.*

Palæosyops grangeri spec. nov.

(Fig. 9.)

Type locality.— Twin Buttes, Bridger Basin, level C1.

Type.— A palate and grinding teeth with portions of the lower jaw and skull. Amer. Mus. No. 12189. (Amer. Mus. Exp. 1904.)

Specific characters.— From level C1 Bridger. Exceeding *P. robustus* in certain dental proportions, p^2–m^3, 165 mm. Fourth superior premolar enlarged (transv., 31). Molars with extremely prominent parastyles and oblique ectolophs.

This is named in honor of Mr. Walter Granger of the American Museum staff, whose explorations have transformed our knowledge of the Bridger animals.

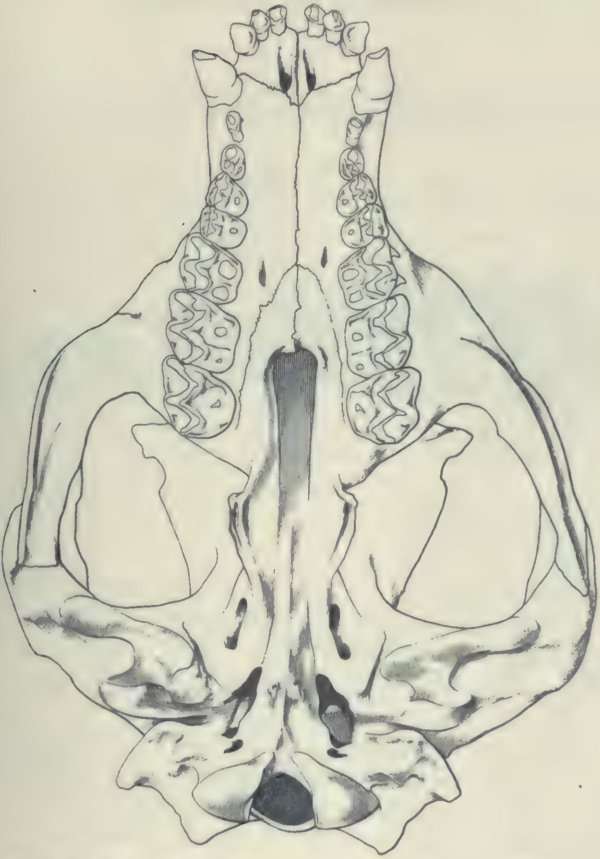


Fig. 8. *Palæosyops leidyi.* Type. Skull, inferior view. No. 1544 Amer. Mus. × ⅓.

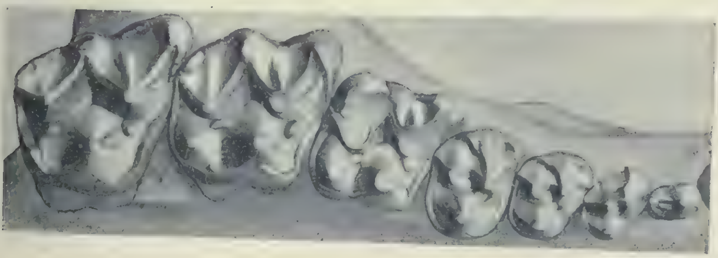


Fig. 9. *Palæosyops grangeri.* Type. Upper dentition, right side. No. 12189 Amer. Mus. × ½.

Palæosyops copei spec. nov.

(Fig. 10.)

Type locality.— Lone Tree, Henry's Fork, Bridger Basin, level D3.

Type.— A series of superior grinding teeth, No. 11708 Amer. Mus. (Expedition of 1903.)

Specific characters.— From level D3 Bridger. Apparently the last of the *Palæosyops* phylum. Of more diminutive size (p^2–m^3, 153 mm.), but the most progressive species of *Palæosyops* known in the evolution of its superior premolars and molars. Heavy cingula embracing the inner sides of the crowns. A rudimentary tetartocone on p^2.

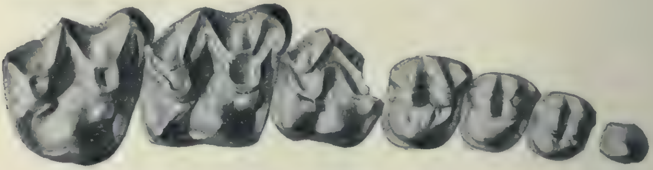


Fig. 10. *Palæosyop's copei.* Type. P^1–m^3, right. No. 11708 Amer. Mus. × ½.

Named in honor of the late Professor E. D. Cope, the describer of *Lambdotherium, "Palæosyops" borealis,* and other species of Eocene Titanotheres.

2. *Second Broad-skulled Phylum,* MANTEOCERAS.

There is little doubt that *Manteoceras* Hatcher[1] (of the Upper Bridger and Lower to Upper Washakie) represents the broad-skulled phase of that stock which gave rise to the long-skulled phyla *Mesatirhinus, Metarhinus,* and *Dolichorhinus.*

The type species of the genus is:

Manteoceras manteoceras (Osborn MS.) *Hay.*

Type.— A skull lacking the dentition, No. 1569, Amer. Mus. from the Washakie Basin, Wyoming.

Paratype.— An incomplete skull, No. 1570 Amer. Mus., with dentition. In the original description by Osborn the type skulls were referred to "*Telmatotherium validens* Cope."

In Hay's catalogue[2] this species is entered as '*Manteoceras manteoceras* Osborn,' but under modern rules of nomenclature this name is technically attributable to Hay, since in his catalogue this manuscript name is printed together with the designation of the figure and description of the type specimens.[1]

---

[1] Amer. Naturalist, Vol. XXIX, 1895, p. 1090.

[2] Bibliography and Catalogue of the Fossil Vertebrata of North America, 1902, p. 632.

Manteoceras washakiensis spec. nov.

(Fig. 11.)

Type locality.— Base of Haystack Mountain, Washakie Basin, Wyoming. Geological level, summit of the Lower Washakie (A).

Type.— A well preserved skull with dentition, No. 13165 Amer. Mus. Discovered by Mr. Paul Miller of the American Museum expedition of 1906.

Specific characters.— Distinguished from *M. manteoceras* of a somewhat lower geological level by its more progressive characters as follows: canines short, obtuse, recurved; internal lobes of pm^2, pm^3 broadening, with shelf for development of deuterocone; p^2 (ant. post. 19 mm., transv., 17) with marked external convexities and a reduced external cingulum; p^3 (ant. post. 19, transv. 25) exhibits the tetartocone fold somewhat more conspicuously than in the most progressive Bridger level D specimens. P^4 (ant. post. 24 by trans. 30) is progressive in transverse measurement and in the development of the tetartocone shelf. The molars are progressive in their large size (m^2 ant. post. 42, transv. 48), in the strong development of the internal cingulum, and in the elongate ectolophs.

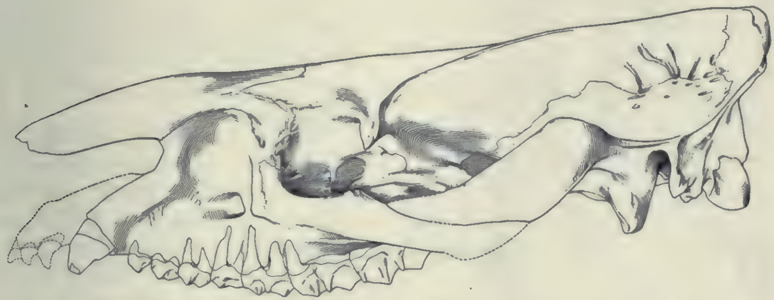


Fig. 11. *Manteoceras washakiensis.* Type. No. 13165 Amer. Mus. × ¼.

The species is so named because it is a more recent phase, probably characteristic of the Washakie rather than of the Bridger.

---

[1] Osborn, Bull. Amer. Mus. Nat. Hist., Vol. VII, 1895, pp. 87–90, figs. 7, 8.

3. *The Narrow-skulled Phyla,* MESATIRHINUS, METARHINUS *and* DOLICHORHINUS.

Mesatirhinus gen. nov.

Type species.— *Palæosyops megarhinus* Earle.[1]

Generic characters.— Levels Bridger C and D, Washakie A, and base of Washakie B. Titanotheres of small size (skull length 354–425 mm.), typically mesaticephalic, persistent or progressing to dolichocephalic. The horns when present are incipient or rudimentary, chiefly borne on the nasals. An infraorbital shelf. Cranium with a sagittal crest. Molars with flattened outer cusps, reduced conules. Humerus relatively abbreviated, *i. e.*, with reference to *Palæosyops*; carpus and tarsus narrow, astragalus with elongate neck, sustentacular distal and cuboidal facets continuous and forming a reversed L (⅃); metapodials slender.

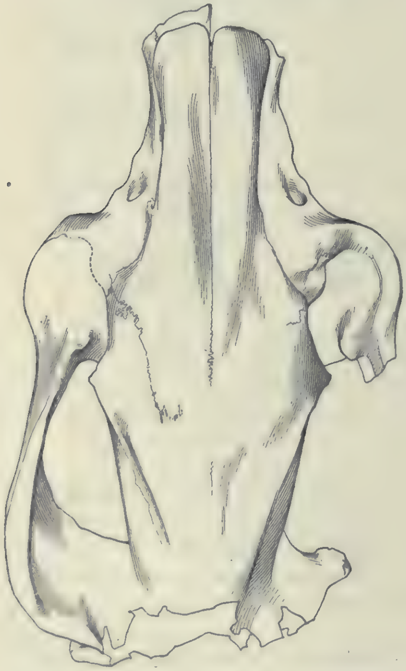


Fig. 12. *Mesatirhinus petersoni.* Type. Skull, top view. No. 12184 Amer. Mus. × ⅛.

Mesatirhinus petersoni spec. nov.

(Fig. 12.)

Type.— A skull with dentition, Amer. Mus. No. 12184, from Cat-tail Spring, Bridger Basin, level D 3. Discovered by Mr. Miller, Amer. Mus. Expedition of 1904.

Specific characters.— Levels: Bridger D (also C3) and Washakie A. Pm^1–m^3, 156 mm.; m^1–m^3, 90. Skull length, premaxillaries to condyles 412 (estimated); preorbital facial region more elongate (217). Other characters as in *Mesatirhinus megarhinus*, that is, broad occipital condyles, broad infraorbital shelf on malar, etc.

Comparison of this animal with the type of *M. megarhinus* can leave no doubt that we have to do here with a much more advanced stage of evolution. The skull is longer, the preorbital region especially. The grinding teeth occupy more space and there is an average advance in all the rectigradations which proves that the differences in form and size are not merely due to fluctuations of size or differences of sex.

---

[1] Amer. Naturalist, Vol. XXV, Jan. 1891, pp. 45–47, 1 fig.

The species is named in honor of Mr. O. A. Peterson, now of the Carnegie Museum, whose titanothere collections in the Uinta formation, greatly extended our knowledge.

IV. SPECIES CHIEFLY FROM THE UPPER WASHAKIE ("HORIZON B") AND LOWER UINTA ("HORIZONS A, B"), MIDDLE AND UPPER EOCENE.

Metarhinus earlei.	*Dolichorhinus intermedius.*
Metarhinus fluviatilis.	*Dolichorhinus hyognathus* ("*cornutus*").

3. *The Narrow-skulled Phyla* (continued).

Metarhinus *Osborn* gen. nov.

Type species.— *Metarhinus fluviatilis* Osborn (*vide infra*).

Generic characters.— Levels Washakie B, Uinta A and B. Small titanotheres (skull length 355 to 440 mm.), persistently mesaticephalic. Narrow, abbreviated preorbital region, premaxillary symphysis greatly elongated and anterior narial openings deeply recessed in side view. Infraorbital shelf present, or wanting (*M. diploconus*); occipital condyles narrow. Grinding teeth subhypsodont; premolars progressive; hypoconulid of m_3 small, conic.

The name alludes to the somewhat later geological appearance of this genus as compared with *Mesatirhinus.*

This apparently represents a dwarfed and possibly fluviatile side phylum, leaving no descendants.

Metarhinus fluviatilis spec. nov.

(Fig. 13.)

Type locality.— Uinta Basin, Utah, Level A.

Type.— A skull, No. 1500 Amer. Mus., discovered by the American Museum expedition of 1893 in the lower horizon (A) of the Uinta Basin.

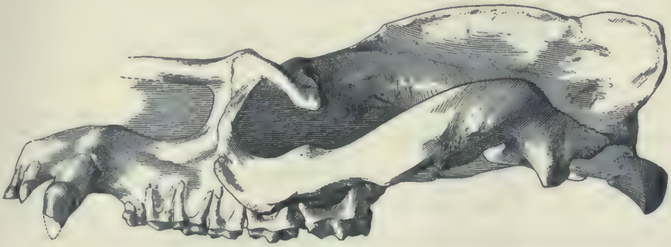


Fig. 13. *Metarhinus fluviatilis.* Type. No. 1500 Amer. Mus. × ½.

Specific characters.— Levels Uinta A and B. Pm^1–m^3 = 144 mm. A relatively short (355e), broad (200e) skull. Eye sockets small and very prominent. Premaxillary symphysis elongate, grinding teeth subhypsodont, m^3 with a cingulum-hypocone in the type.

The name is given in allusion to the possibly river-living or amphibious habits of the animal.

Metarhinus earlei spec. nov.

(Fig. 14.)

Type locality.— North side of Haystack Mountain, Washakie Basin, Wyoming; level, Washakie B.

Type.— A skull (No. 13166, Amer. Mus., Expedition of 1906) lacking the nasals.

Specific characters. — Level Washakie B. Pm^1–m^3 = 167 mm. Skull proportions, length 380, breadth 230. Narrow occipital condyles. Extremely elongate premaxillary symphysis. A short sagittal crest. No hypocone on m^3.

This animal is readily distinguished from *M. diploconus* by: (1) the infraorbital shelf of the malars; (2) the elongate premaxillary; (3) the absence of a double cone on m^3. In many other respects it resembles *M. diploconus*, especially in its proportions. It is distinguished from *M. megarhinus* by: (1) the elongate premaxillary symphysis, correlated with the long narrow facial region; (2) the narrowness of its occipital condyles. It is distinguished from *M. fluviatilis* by: (1) its greatly superior size and (2) the lesser prominence of the orbits.

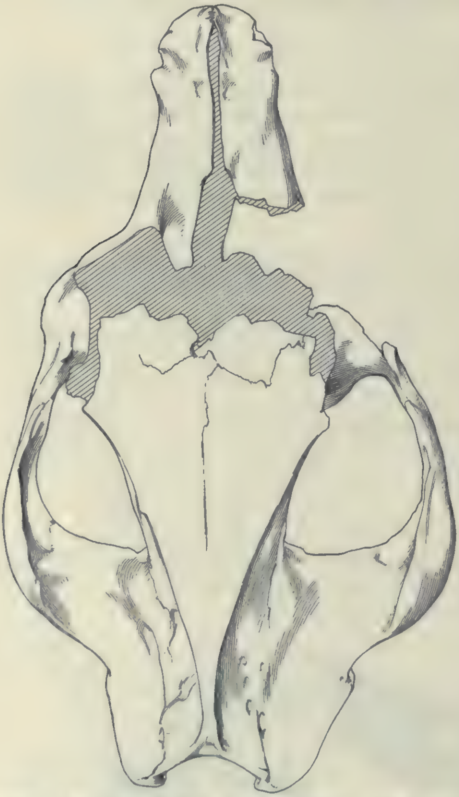


Fig. 14. *Metarhinus earlei.* Type. Skull, top view. No. 13166 Amer. Mus. × ¼.

The species is named in honor of Charles Earle, the first monographer of the genus *Palæosyops* and its allies.

Dolichorhinus intermedius spec. nov.

(Fig. 15.)

Type locality.— Uinta Basin, northeastern Utah, level B. Age of Upper Washakie beds.

Type.— A skull with dentition, No. 1837 Amer. Mus., discovered by the American Museum expedition of 1894.

Specific characters.— Level Uinta B. Distinguished from *D. hyognathus* Scott and Osborn by (1) its inferior size (pm^1–m^3 = 179), m^1–m^3 = 109 mm.; (2) premolars less progressive, with subconic deuterocones; (3) all cingula less robust; (4) nasals more pointed and less expanded distally; (5) infraorbital shelf of malar relatively narrow.

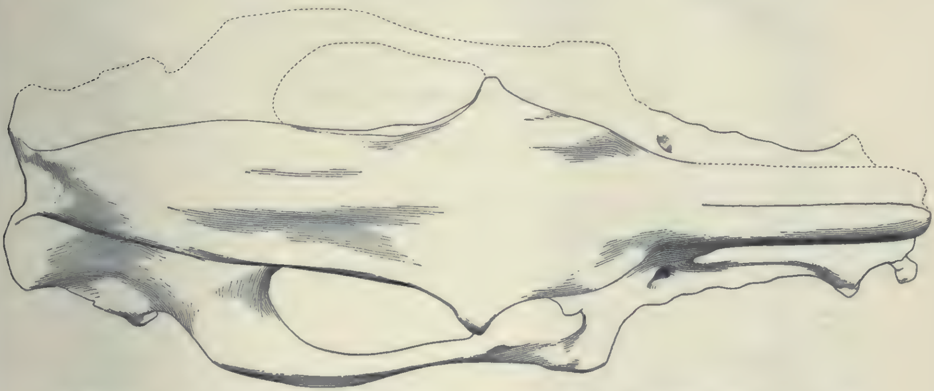


Fig. 15. *Dolichorhinus intermedius.* Type skull, top view, No. 1837 Amer. Mus. × ¼.

The name '*intermedius*' is given because in some characters this species is intermediate between *Mesatirhinus petersoni* and *Dolichorhinus hyognathus,* although on the whole it is much more nearly allied to the latter.

Dolichorhinus hyognathus (*Scott and Osborn*).

Syn. *Telmatotherium cornutum* Osborn.

(Fig. 16.)

It is unfortunate that the appropriate specific name *cornutus* (applied to a Uinta B type) must give way to the prior name *hyognathus* (applied to a Washakie B type) based upon a very large lower jaw found in the Washakie basin by the Princeton expedition of 1878. The American Museum expedition of 1906 proved that the deposits of the type localities (Middle Uinta

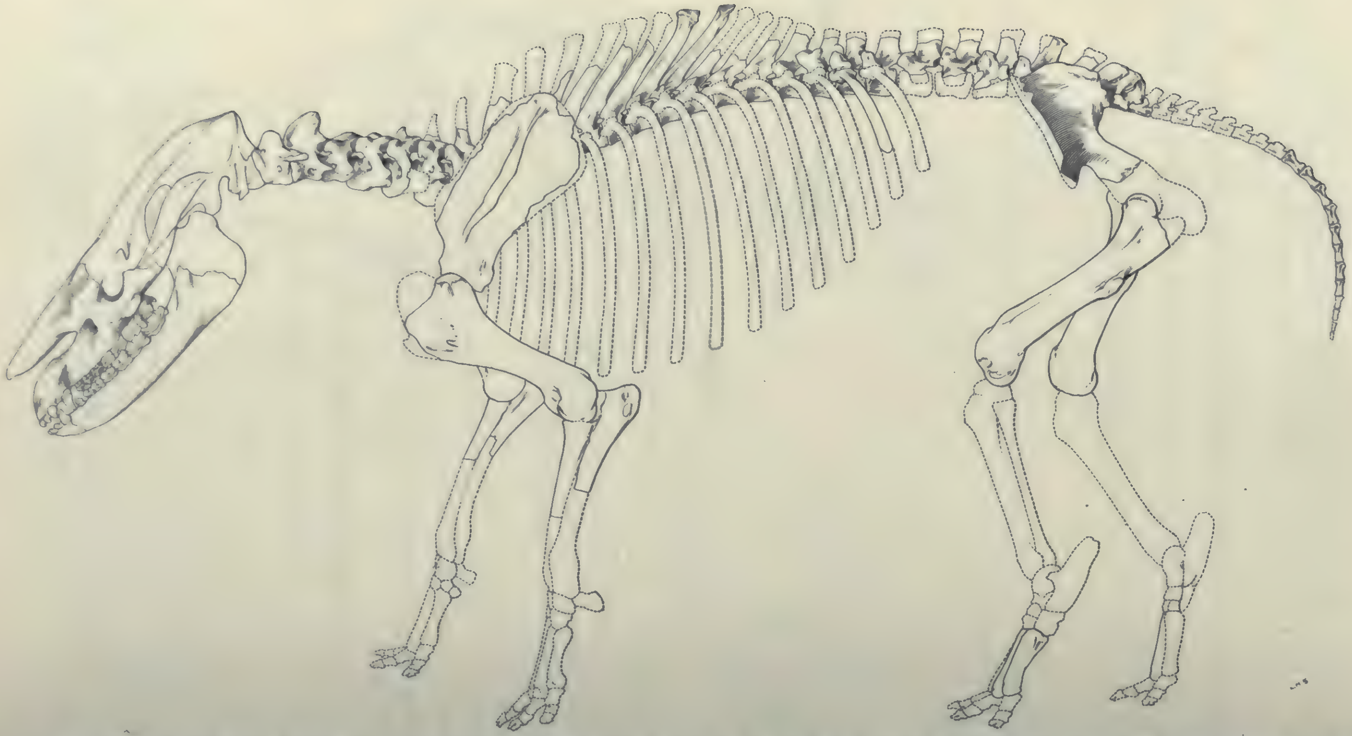


Fig. 16. *Dolichorhinus hyognathus.* Reconstruction of skeleton. Anterior half of skull, ramus of lower jaw, backbone, ilium, from No. 1843 Amer. Mus. (from Uinta B); parts in outline (except scapula) from No. 13164 (from Washakie B); remaining limb bones from various Uinta B. specimens; ribs hypothetical. × $\frac{1}{12}$.

and Upper Washakie) were formed contemporaneously and that both are sharply characterized by the presence of the long-skulled animal named *Dolichorhinus* by Hatcher. The accompanying reconstruction (Fig. 16) of this animal gives an idea of its peculiar proportions.

V. SPECIES FROM THE UPPER UINTA (HORIZON C), UPPER EOCENE.

Telmatherium ultimum.
Telmatherium (?) *altidens.*
Protitanotherium superbum.

Telmatherium ultimum spec. nov.

(Fig. 17.)

The type of this genus is *Telmatherium validum* Marsh from the Upper Bridger. The phylum is an important and distinct one but its remains are scarce. It is really more nearly affiliated to the *Palæosyops-Limnohyops* phylum and represents the long-skulled phase of the stock which gave rise to the above genera.

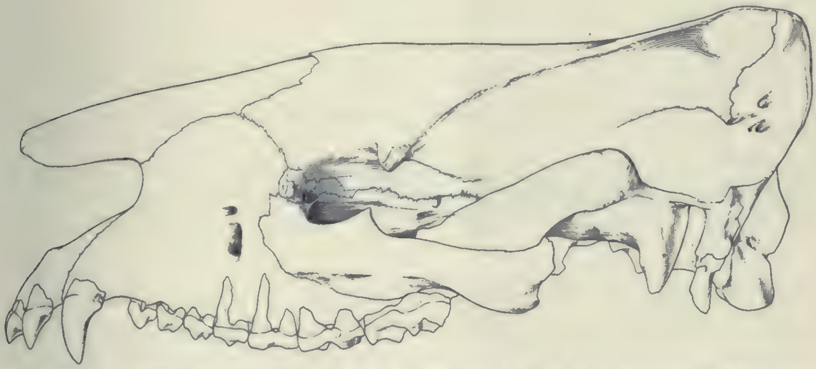


Fig. 17. *Telmatherium ultimum.* Type. No. 2060 Amer. Mus. The skull is somewhat deepened by pressure. × ⅙.

Nomenclature.— This species was mentioned by Matthew[1] as *Palæosyops ultimus* Osborn MS., but as no type was indicated or specific diagnosis given, the name remained a *nomen nudum* until now validated by the designation of a type.

---

[1] *Amer. Naturalist,* Vol. XXXI, 1897, pp. 57–58.

Type locality.— Uinta formation, northeastern Utah, Horizon C (lower levels).

Type.— A well preserved skull with dentition No. 2060 Amer. Mus., discovered by Mr. Peterson of the American Museum expedition of 1895.

Specific characters.—From lower portion of Uinta C. P^1–$m^3 = 226$. Lateral superior incisors greatly enlarged, caniniform. Pm^2, ^{3},^{4} with internal subcrescentic deuterocone ridges, with faint rudiments of tetartocones posteriorly. Ectolophs of premolars elevated and biconvex.

The specific name *Telmatherium ultimum* is given because this appears to be the last representative of the *Palæosyops-Limnohyops-Telmatherium* group.

Telmatherium (?) **altidens** spec. nov.

(Fig. 18.)

Type locality.— Uinta Basin, northeastern Utah, horizon (level) C.

Type.— A lower jaw with dentition, No. 2025 Amer. Mus., discovered by the American Museum expedition of 1895.

Specific characters.— From Upper Uinta, level C. Pm_1–$m_3 = 330$ mm.; a wide diastema (70) behind the canines. Canines in male exceptionally elevated (76) and pointed. P_1, p_2 laterally compressed, non-molariform; p_3, p_4 submolariform; dolichocephalic, anterior portion of face elongate.

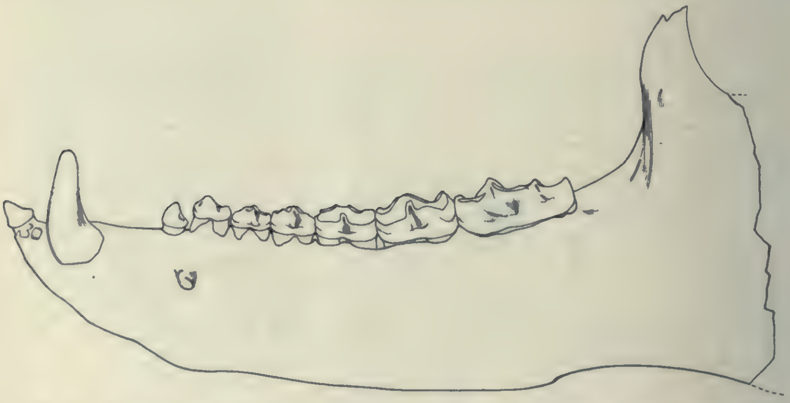


Fig. 18. *Telmatherium* (?) *altidens.* Type. Left ramus of lower jaw. No. 2025 Amer. Mus. × ⅙.

Generic reference.— The generic reference to *Telmatherium* is provisional.

The specific name refers to the very high-crowned piercing canine.

Protitanotherium superbum spec. nov.

(Fig. 19.)

Type locality.— Uinta basin, northeastern Utah, "Horizon C."

Type.— A well preserved lower jaw, No. 2501 Amer. Mus., discovered by the American Museum expedition of 1895.

Specific characters.— From Upper Uinta, Horizon C, probably higher levels. P_1–m_3 = 318 mm. Canines in males very robust; p_1 double-fanged; post canine diastema abbreviated; premolar series relatively abbreviated; p_2 with very large talonid and crescentic protoconid; p_3, p_4 with talonid heavy and prominent, *i. e.*, submolariform, but no entoconid. M_3 with hypoconulid sharply constricted off at base.

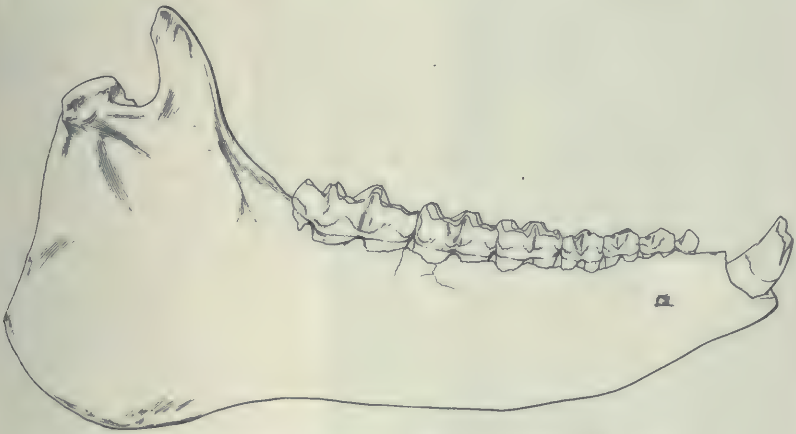


Fig. 19. *Protitanotherium superbum.* Type. No. 2501 Amer. Mus. × $\frac{1}{8}$.

The name is given in reference to the great size and presumed power of this Uinta Titanothere which considerably exceeds that of the smaller Oligocene titanotheres.

VI. Species from the White River Formation, Oligocene.

Brontotherium hatcheri. *Symborodon copei.*

Brontotherium hatcheri spec. nov.

(Fig. 20.)

Type locality.— South Dakota. Level, Middle Titanotherium Beds, Lower Levels. J. B. Hatcher, collector.

Type.— A nearly complete skull No. 1216 (skull A) U. S. Nat. Mus., lacking the premaxillaries and anterior portion of the maxillaries.

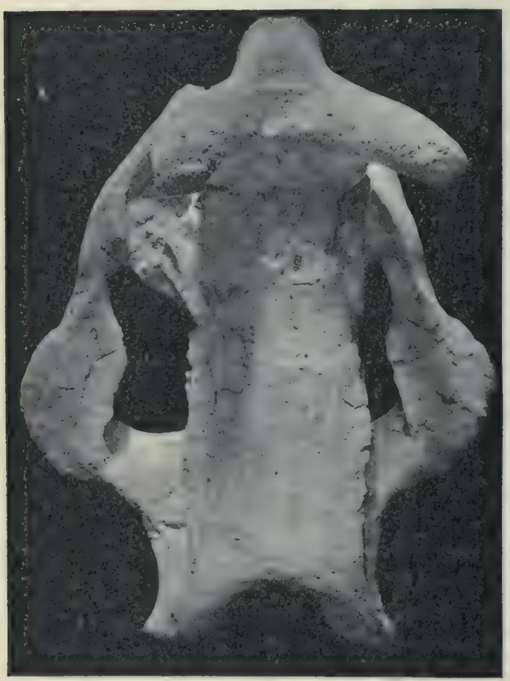


Fig. 20. *Brontotherium hatcheri.* Type. Superior view of skull. No. 1216 U. S. Nat. Mus. × $\frac{1}{10}$.

Specific characters.— $I\frac{2}{2}$, $p\frac{4}{4}$. Nasals moderately long (97 mm.), thin at the edges. Horns 250+ mm. two-thirds the length of the *B. gigas* horns. Skull length (pmx-condyles) 710 est., width across zygomata 530 est. This species appears to represent an early phase of evolution of *B. gigas.* The horns are very round or convex in section, and have a well defined malar ridge on the lower outer portion. The connecting crest is relatively shallow, and the nasals are thin. The premolars are well advanced, the tetartocone of p^4 being well rounded and quite distinct.

Materials.—The referred material includes a second skull No. 4255 (skull Q) in the National Museum, the anterior portion of a skull (No. 1070) associated with a lower jaw, in the American Museum, and finally a very complete skull (No. P 5926) in the Field Museum.

The species is named in honor of the late J. B. Hatcher, who discovered many of Professor Marsh's titanothere types, brought together the great collection of titanotheres in the National and Yale Museums, and placed the stratigraphic succession of the species upon a secure basis.

Symborodon copei spec. nov.

(Fig. 21.)

Type locality.— South Dakota. Level probably Middle Titanotherium Beds. J. B. Hatcher, collector.

Type.— A complete skull No. 4711 (skull V) U. S. Nat. Mus., collected by J. B. Hatcher, 1888.

Specific and generic characters.— Incisors (type) persistent but greatly reduced; canines very small, reduced (28 mm.); premolars with cingula reduced or absent; tetartocones connected with deuterocones by a longitudinal ridge. *Skull*: nasals thin, short and broad in proportion, 80 mm. × 125 mm.; horns, ♂, 300, no connecting crest, transverse oval near summit; buccal processes of zygomata ♂ stout and convex; malar in front of buccal process very deep, beneath post-orbital process stout, convex; occipital pillars not greatly expanded at the summits.

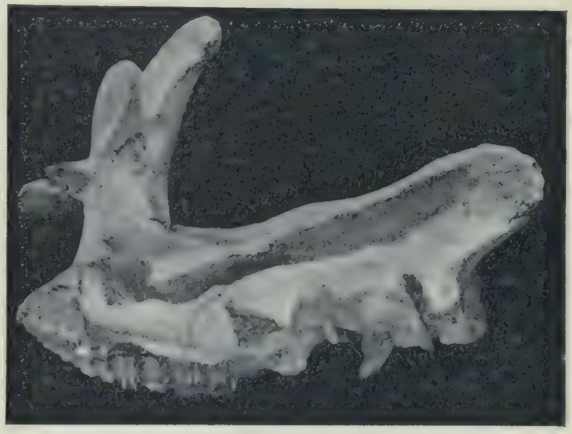


Fig. 21. *Symborodon copei.* Type. No. 4711 U. S. Nat. Mus. × $\frac{1}{10}$.

Materials. — This species is known only from the type skull.[1]

The skull differs from *Brontotherium gigas* especially in the position of the horns, which are placed very much farther back, immediately in front of and above the orbits, with buttresses extending backward at the base over the orbits. The horns thus obtained a good firm support posteriorly, a mechanical adaptation that compensates for the entire lack of a transverse connecting crest between the bases of the horns, this condition contrasting sharply with the deep connecting crest of *B. gigas.*

---

[1] Figured in Osborn, 'The Four Phyla of Oligocene Titanotheres,' Bull. Amer. Mus. Nat. Hist., Vol. XVI, 1902, p. 104, fig. 8 (*Symborodon? montanus*).

59.57.96(74.1)

Article XXXIII.— THE ANTS OF CASCO BAY, MAINE, WITH OBSERVATIONS ON TWO RACES OF FORMICA SANGUINEA LATREILLE.

By William Morton Wheeler.

The following study of the ants of Casco Bay was made during July of the current year while I was spending my vacation at the Tuft's College Marine Laboratory at South Harpswell. In making this study I am greatly indebted to the director of the laboratory, Professor H. V. Neal of Knox College, who not only interested himself greatly in the work but put himself to considerable inconvenience to take me in the laboratory launch to several points in the bay.

As yet no systematic study of the ants of Maine has been undertaken. In my list of the Formicidæ of New England [1] I recorded 14 forms from the State. Those since collected in the Casco Bay region comprise twice that number. It is certain that these represent only a portion of the fauna, but I believe that there can be hardly more than 35 or 40 species, subspecies and varieties in the whole State. On this supposition, Maine, though four times as large as New Jersey, would have less than half as large a formicifauna. The boreal character of this fauna is very pronounced, especially in the Casco Bay Region. Indeed, the rocky, heavily glaciated southernmost islands and the tips of the slender peninsulas, which are bathed by the icy Arctic Current and in winter swept by bleak winds from the ocean, have an ant-fauna essentially like that of the White Mountains and Nova Scotia. Unquestionably this is true also of the remaining islands and peninsulas of the Maine coast northeast of Portland. The bases of the peninsulas, the adjacent continental shores, and the more sheltered islands in their immediate neighborhood, however, are considerably warmer and are therefore inhabited by many forms common to Massachusetts, Connecticut, New York and other more southern localities. This striking contrast between the regions exposed to the cold currents of air and water and the inland regions is beautifully apparent in the flora, and can be readily followed during a journey of less than 20 miles from the tip of Harpswell Neck to its junction with the mainland. At the tip and on the adjacent islands the forests are almost pure formations of black spruce (*Picea nigra*), but pines and deciduous trees increase in number to the northward and the latter predominate near the Gurnet. The conditions are therefore comparable to a descent from the cold bogs and spruce woods of the White Mountains at an altitude of 1500 to 2000 feet to the deciduous forests of much lower elevations. Sensitive insects like the ants, would, of course, be expected to vary adaptively in different portions of such a region, and we find, therefore, at the southern extremity of Harpswell Neck, on Haskell Island and Ragged Island, only a few decidedly boreal species, whereas nearly the entire series of the subjoined list occurs in such sheltered spots as Prince's Point near the Gurnet and at the north end of Sebascodegan Island. One species, *Formica fusca,* exhibits a very interesting geographical variation. Out in the cold current among the spruce trees, and even on bleak and treeless islands, almost the only ant is a boreal variety, *glacialis,* closely resembling the typical *fusca* of the Alps and northern Europe, but further inland, among the deciduous forests, it is replaced by the larger and more silvery pubescent variety *subsericea,* which is the common form throughout the Northeastern States and Canada. There occurs also in the Casco Bay region, but very sparingly, a third variety, *argentata,* with very silvery body and reddish legs. This is also a boreal form, with its true center of distribution in the mountains of British Columbia and Colorado. Although the title of this paper may seem to be somewhat presumptuous, since I have explored only a small portion of Casco Bay, I nevertheless believe that further researches will add few species to my list or materially modify the general remarks which I have deemed it safe to make.

---

[1] Fauna of New England, 7. Occas. Papers Boston Soc. Nat. Hist., VII, 1906, pp. 1–24.

I expected to find at South Harpswell an excellent field for continuing my studies on *Formica sanguinea,* an ant by no means abundant in the neighborhood of New York. I was not disappointed. Colonies of two of our American subspecies, *subintegra* and *aserva,* are extremely common in several places on Harpswell Neck, within easy walking distance from the laboratory, so that I was able to add materially to my former account of these slave-makers.[1] I could have wished to devote the entire summer to my observations and experiments on these insects, but my vacation came to an end and I was obliged to return to New York the first of August.

---

[1] On the Founding of Colonies by Queen Ants, with Special Reference to the Parasitic and Slave-making Species. Bull. Am. Mus. Nat. Hist., XXII, 1906, pp. 33–105, pll. viii–xiv.

I. List of Species, Subspecies and Varieties.

Ponerinæ.

1. **Ponera coarctata pennsylvanica** *Buckley.*— A single worker taken in a spruce clearing under a bit of wood near a nest of *Formica aserva.*

Myrmicinæ.

2. **Cremastogaster lineolata** *Say.*— A few colonies of a small dark form of this species, nesting under the bark of spruce stumps near the Austin cottage, South Harpswell and on Ragged Island.

3. **Stenamma** (**Aphænogaster**) **fulvum** *Roger* var. **piceum** *Emery.*— Only two colonies seen, both nesting under stones, one at South Harpswell, the other on Sebascodegan Island.

4. **Myrmica rubra brevinodis** *Emery* var. **canadensis** *Wheeler.*— Very common in the bogs, nesting in hummocks of moss (*Polytrichum commune*), or under stones and bits of wood.

5. **Myrmica rubra scabrinodis** *Nylander*, var.— The workers of this form are large and reddish and resemble those of the var. *sabuleti* but the lobe at the base of the antennal scape is much larger and more cup-shaped. A few colonies were found among the grass and lichens on the dry heaths near South Harpswell.

6. **Myrmica rubra scabrinodis** var. **fracticornis** *Emery.*— This form occurs in dry bogs and shady spruce clearings. Several fine colonies were found on Lower Goose Island and Sebascodegan Island.

7. **Leptothorax acervorum canadensis** *Provancher.*— Isolated workers taken on the bark of spruce logs and stumps at Stover's Point, near South Harpswell, and on Ragged Island.

8. **Leptothorax emersoni** *Wheeler.*— This interesting little ant, which always lives in symbiosis with *Myrmica canadensis*, was found in several localities near South Harpswell. It is particularly abundant in a bog near the spring at Stover's Point.

9. **Leptothorax curvispinosus** *Mayr.*— A fine colony of a small, pale variety of this species was found living in a curled dead leaf at the roots of a huckleberry bush in a dry bog near the Austin cottage at South Harpswell.

Dolichoderinæ.

10. **Dolichoderus pustulatus** *Mayr.*— The typical, coarsely sculptured form of this species, with large yellow spots on the gaster, is common in the

bogs near the Austin cottage and on Sebascodegan Island. Its colonies are small and live under the dead leaves about the roots of shrubs. The workers wander about singly and attend aphids. July 24 a fine deälated female was found running over the ground.

11. **Dolichoderus taschenbergi** *Mayr* var. **gagates** *Wheeler.*— Several files of foraging workers of this form were seen in the same locality as the preceding, but I was unable to locate any of the nests. The colonies were smaller and more depauperate than those which I have observed at Lakehurst, N. J. July 24 several deälated females, evidently just alighted from their nuptial flight, were found running over the ground.

12. **Tapinoma sessile** *Say.*— This ant seems not to occur at the lower end of Harpswell Neck or on the outlying islands, but is common in dry, sunny places at Prince's Point and on Lower Goose Island. The workers are smaller and more silvery than the typical *sessile* and have yellow knees and tarsi. This same form is common in the mountains of New Jersey and New York.

Camponotinæ.

13. **Brachymyrmex heeri depilis** *Emery.*— A few colonies of this minute ant were found under lichens and stones at South Harpswell, Lower Goose Island and Prince's Point.

14. **Lasius niger** *L.* var. **neoniger** *Emery.*— The worker of the typical form of this variety has the large stature and pilosity of the typical palearctic *niger,* but it is of a pale yellowish or brownish color and has very distinct ocelli. Smaller, darker forms, with less pubescence and forming transitions to some of the subvarieties of var. *americanus* Emery and the European *alienus* Först. occur in many localities throughout the Northern States. *L. neoniger* is also closely related to the var. *sitkaënsis* of Alaska but, according to Pergande's description, must be somewhat smaller and more pilose. The female of *neoniger* is much larger (9–10 mm.) than that of *americanus,* and has the coloring and pilosity of the worker. The wings are long (9.–9.5 mm.) and tinged with yellowish.

I have found this variety only in moist localities, especially in sunny, subalpine meadows and, in the Casco Bay region, in bogs near the seashore. It is very common at South Harpswell and on Ram, Haskell, Ragged, Lower Goose and Sebascodegan Islands. The specimens from these localities are exactly like a long series in my collection taken at Digby, Nova Scotia (J. Russell), Montreal, Canada (Miss A. Rucker), Selkirk Mts., British Columbia (J. C. Bradley), Fabyan, N. H.; Litchfield Hills, Conn.

(W. M. Wheeler), Black Mts., N. C. (W. Beutenmüller), Giant Forest, Cala. (J. C. Bradley), King's River Cañon, Cala. (H. Heath), Moscow, Idaho (J. M. Aldrich), Corvallis, Oregon; Olympia, Washington (T. Kincaid), and Beulah, New Mexico (T. D. A. Cockerell).

15. **Lasius niger** *L.* var. **americanus** *Emery.*— Common on dry, sunny heaths where it builds small crater nests or lives under stones, boards, etc. Like the European *alienus,* this is a hairless or nearly hairless xerothermic variety of *niger.* When nesting in shady woods or damp spots it usually has a darker color and may develop a few erect hairs on the scapes and legs, thus approaching the smaller and darker forms of *neoniger.*

16. **Lasius brevicornis** *Emery.*— Common under stones and in dry bogs in the northern portions of Casco Bay. One colony was found on Haskell Island.

17. **Lasius** (**Acanthomyops**) **claviger subglaber** *Emery.*— Several large colonies of this beautiful ant, containing mature winged females, were observed on Sebascodegan Island, July 23. In the evening while returning from this locality to South Harpswell in the launch, I saw thousands of these females on the surface of Harpswell Sound where they had fallen from their nuptial flight during the afternoon. They were, of course, unable to rise in the air and were eagerly devoured by the fishes.

18. **Formica exsectoides** *Forel.*— Only three colonies of this ant, and these all of small size, were seen; one in a dry bog at South Harpswell and two in an open, sunny pasture at Prince's Point. None of the nests measured more than two feet in diameter. The depauperate condition of these colonies indicated that Casco Bay must be near the northernmost limit of the range of this "mound-building ant of the Alleghanies."

19. **Formica rufa obscuriventris** *Mayr.*— A fine colony of this form, which I had redescribed as *F. dryas* before seeing Mayr's types in Professor Forel's collection, was found nesting under a pile of stones at Doughty's Point on Sebascodegan Island. There were many winged males but no females in the nest.

20. **Formica rufa integra** *Nylander.*— A few fine colonies of this subspecies were seen on Lower Goose Island and at Prince's Point. One of these colonies contained many males and a few winged females (July 24). It is a significant fact that both *F. integra* and *F. exsectoides* were found only in localities where *F. subsericea,* their temporary host, abounds, and not in colder regions where *glacialis* is the prevailing or only form of *fusca.*

21. **Formica sanguinea aserva** *Forel.*— Very common on Harpswell Neck, at Ash Point, and Prince's Point, on Lower Goose and Sebascodegan Islands, but no trace of it could be found on Haskell or Ragged Islands. A fuller account of this and the following subspecies is given below.

22. **Formica sanguinea subintegra** *Emery.*— Emery regarded this as a variety of the subspecies *rubicunda,* but after examining a long series of specimens from many localities in the Northern States, I deem it preferable to regard it as an independent subspecies. It is common in the same localities as the preceding form and is also absent on Haskell and Ragged Island, though its slave, *F. glacialis,* is extremely common in both of these places.

23. **Formica fusca** *L.* var. **glacialis** var. nov.

The worker of this form averages smaller than those of vars. *subsericea* and *argentata* (5–6 mm.) and is deep black, with only the mandibles, scapes, base of funiculus, knees, trochanters and tarsi reddish. The pubescence on the body is decidedly shorter and more dilute, so that the surface appears smoother and more shining, but less so than in the var. *subænescens* Emery.

The female, too, is smaller than in the varieties *subsericea, subænescens* and *argentata* (7–8 mm.), and the gaster is decidedly shining. Color and pubescence as in the worker. Wings tinged with greyish as is *subsericea* and *subænescens,* not colorless as in *argentata.*

The male, measuring 9–10 mm. is slender, with black antennæ and yellow legs; coxæ, trochanters, and bases of femora black or infuscated. Wings as in the female. External genitalia infuscated; pubescence of gaster longer than in *subænescens* but shorter than in *subsericea.*

The type locality is South Harpswell. It is common also in most of the above mentioned localities in Casco Bay but is replaced by the var. *subsericea* in warmer and more sheltered spots. There are series of the var. *glacialis* in my collection from the following localities: Digby, Nova Scotia (John Russell), Cod Roy, Newfoundland (L. Gratacap), Bedford, N. Y. (Wheeler), Franconia, N. H. (Mrs. A. T. Slosson), Fabyan, N. H. (Wheeler).

F. glacialis is the most abundant and conspicuous ant of the Casco Bay region, as it constructs large masonry dome nests from one to four feet in diameter at the base and four to ten inches high, often covered with grass or *Polytrichum commune.* They appear as hummocks both in clearings in the spruce woods and in the open fields. Less frequently this ant is found nesting in old stumps or under stones. It is certainly very closely related to *subænescens* and to the typical European *fusca,* but differs from the former in the smaller size and greater number of its workers. Moreover, I have never found *subænescens* living in masonry dome nests but only under bark or stones in woods, nor are the domes of the European *fusca* as large or conspicuous as those built by the new variety. The males and winged females appear during the latter half of July. The workers are the normal slaves of *F. subintegra* and *aserva* in the Casco Bay region and, of course, the only slaves in the cold localities where *F. subsericea* is lacking. On the golden rod plants near the laboratory at S. Harpswell I found the workers of *glacialis* assiduously attending small Membracids (*Publilia concava* Say), which were all stationed singly on the leaf petioles a short distance from the points where they had oviposited.

24. **Formica fusca** *L.* var. **subsericea** *Say.*— Rare and sporadic near South Harpswell and apparently lacking on the outlying islands (Haskell, Ragged, Ram and Orr's), this form is more abundant at the northern end of Sebascodegan and Lower Goose Islands and on Prince's Point. The colonies are smaller and more concealed and the workers are conspicuously larger than those of *F. glacialis.*

25. **Formica fusca** *L.* var. **argentata** *Wheeler.*— A few colonies of this form were taken from small concealed nests under stones at South Harpswell, on Sebascodegan and Lower Goose Islands.

26. **Formica subpolita** *Mayr* var. **neogagates** *Emery.*— Common on the dry heaths near the Austin cottage at South Harpswell and on Prince's Point, Lower Goose and Sebascodegan Islands.

27. **Camponotus herculeanus** *L.*— Not uncommon in the decaying logs and stumps in the spruce clearings. I have taken it on Harpswell Neck, Lower Goose Island, Prince's Point and Sebascodegan Island. On Ram Island I took a single winged female which must have flown from the adjacent islands or mainland, as there is no timber on this island.

28. **Camponotus herculeanus ligniperdus** *Latr.* var. **novæboracensis** *Fitch.*— This is the more common form of the species in all the localities mentioned and also on Ragged and Haskell Islands. Like the European *ligniperdus* it often nests under stones. I could find no traces of the entirely black subspecies *pennsylvanicus* De Geer or its variety *ferrugineus* Fab., both of which are the most common forms further south and west.

II. MYRMECOPHILES.

The only myrmecophiles encountered in ant-nests in the vicinity of S. Harpswell were the following:

1. **Microdon tristis** *Loew.*— July 11 a single young larva of this Syrphid was found in Basin Cove on Harpswell Neck in the gallery of a *Formica aserva* colony that was nesting in a rotten stump. In the same locality and in another nest of the same ant a number of old and empty puparia were seen.

2. **Cremastochilus castaneæ** *Knoch.*— July 18 I found in a nest of *F. glacialis* at Stover's Point 11 larvæ of this beetle. The nest was a typical

masonry dome with some vegetable detritus collected on its summit. The larvæ, mostly full grown, were scattered through the earth at a depth of between three and six inches below the surface. As soon as they were exposed by the trowel the ants attacked them furiously. A twelfth larva was found enclosed in a broadly elliptical earthen cocoon, and preparing to pupate after the manner of other Cetoniids. The larvæ and incipient pupa were carefully imbedded in earth in a glass jar and by August 3 had nearly all pupated. The adult beetles hatched August 14–22. As the larva and pupa of this singular myrmecophilous beetle have not been noticed heretofore, I subjoin a description:[1]

Larva.— Length 12–14 mm. Of the usual clavate, scarabæidoid shape and pale drab color, with the abdomen in the region of the ninth and tenth segments darker, owing to the black contents of the intestine. Head moderately convex, but little narrower than the prothoracic segment, nearly twice as broad as long, broadest at its anterior border which is straight; surface obscurely reticulate, rather shining; front with a rather faint Y-shaped sulcus. Ocelli absent. Clypeus regularly transversely rectangular, somewhat more than three times as broad as long, its anterior and posterior angles rather sharp, its disc crossed by an impressed transverse line parallel with the posterior and anterior borders; its surface obscurely rugulose. Labrum longer but somewhat narrower than the clypeus, with rounder anterior corners and faintly trilobed anterior border; surface reticulate, shining, with two obscure longitudinal impressions converging in front. Antennæ turned forward, rather stout, 4-jointed, inserted on conical eminences which simulate basal joints; first joint slightly obconical, three times as long as broad; second joint shorter but of the same form; third but little shorter than the second, produced at the tip on the ventral side into a blunt tooth; fourth as long as the first joint, slightly fusiform, with blunt tip and slightly constricted and attenuate base. Mandibles somewhat shorter than the head, distinctly ridged above, opaque and depressed at the tips, smoother and more convex at the base; right mandible obscurely tridentate, with sharp, blade-like masticatory border, left quadridentate. Legs raptorial, with rather dense, coarse hairs; length slightly increasing from the first to the third pairs; coxæ subequal, subcylindrical, flattened externally, much longer than broad; trochanters obconical, third pair somewhat longer than the others, as is also the case with the femora, tibiæ and ungulæ; femora and tibiæ slightly clavate; ungulæ narrow, subulate, nearly straight, much shorter than the tibiæ. Prothorax duplicate above, meso- and metathorax and first eight abdominal segments triplicate, gradually enlarging posteriorly; ninth and tenth abdominal segments still larger and smooth. Pleuræ triangular, plicate. Spiracles broadly elliptical, with subcentral bulla and minutely cribrate respiratory area. Body covered with sparse, coarse, rather straight, fulvous hairs.

Pupa.— Length 9 mm. Enclosed in an elliptical earthen cocoon 11–12 mm. long, 8–9 mm. in diameter and about .5 mm. thick. The larval exuviæ are crowded to the anal pole and the free pupa has the form of the adult beetle except for the undeveloped condition of the wings and elytra. The scutellum is longer than broad and has a pointed tip.

---

[1] I have recently brought together what is known of the habits of *Cremastochilus* in an article entitled: Studies on Myrmecophiles. I Cremastochilus. Journ. New York Entom. Soc., Vol. XVI, June 1908, pp. 68–79, 3 figg.

The larva of *Cremastochilus castaneæ* resembles that of *Osmoderma*, so carefully figured and described by Schiødte,[1] but the body is shorter and more robust, with a proportionally larger head and stouter legs; the head is shorter, the anterior corners of the clypeus are less acute and its sides are more parallel; the tibiæ are not ovate and the ungulæ are not conical. In the structure of the head and legs (except the ungulæ), the larval *Cremastochilus* is more like the larval *Cetonia*, figured by Schiødte.

III. FORMICA SANGUINEA SUBINTEGRA EMERY.

The great abundance of fine colonies of this slave-making ant in the neighborhood of South Harpswell enabled me to gain a much more satisfactory acquaintance with its habits than has been possible heretofore. Though not uncommon in many localities in the Northeastern States, one rarely happens on localities where its nests can be readily found and inspected, since its usual host, or slave in these regions is *F. subsericea*, an ant which resembles the European *fusca* in concealing its nests. Moreover, the few experiments which I had made at Colebrook, Conn., on its methods of colony formation gave indecisive or negative results so that I desired to reinvestigate the subject.

In the Casco Bay region *subintegra* nests almost exclusively in the typical masonry domes of *F. glacialis*. Nests containing the *subintegra* are usually at once recognized by their very large size (3 and 4 feet in diameter! and this is due to the very pronounced slave-making habits of this race of *sanguinea*. It is never found in unmixed colonies, and not only are its own workers very numerous but they are associated with three to five times as many workers of *glacialis*, so that a single mixed colony often comprises thousands of individuals. The nests are always of the pure *glacialis* type, and if the *subintegra* assists in their construction, as is very probable, it must adhere rigidly to the plan adopted by its slaves. The intense dulotic instincts of *subintegra* are also shown by the magnificence and frequency of its forays. These, as in other races of *sanguinea*, do not begin till the latter part of July, after both the colonies of this species and of the *glacialis*, which it plunders, have given off their yearly brood of males and winged females. Both species are colonially proterandric, that is, the males hatch from the cocoons and mature before the females. The earliest date on which I found mature male *subintegra* was July 10. On the following days callow females made their appearance and both sexes had left their parental colonies by July 24. The first slave-making foray was witnessed on Sebascodegan Island July 23. It is probable that both the maturing of the sexual phases and the occurrence of the forays were much advanced during the past summer, owing to the unprecedented heat and drought during June and July. In normal seasons these occurrences are probably delayed in boreal regions like Casco Bay till the first week in August.

---

[1] De Metamorphosi Eleutheratorum Observationes. 2 vols. Thiete, Copenhagen, 1861–1883.

On the afternoon of July 26 I witnessed at Prince's Point two forays of *subintegra* which for magnitude and interest surpassed any that I had previously seen. Both colonies inhabited large mound nests and behaved in precisely the same manner. The army from one was plundering, about 85 feet from the home nest, a concealed colony of *F. subsericea* in an open field, the other was similarly engaged on a large mound nest of *glacialis* about 60 feet away, and reached by a tortuous path through a dense cluster of spruces. In neither case did the workers of the nest attacked offer any resistance, nor did the *subintegra* exhibit any marked hostility, but hastily carried away the larvæ and pupæ. Strange to relate, however, the marauders did not confine themselves to this booty but carried home also the callow and mature *subsericea* and *glacialis* workers. The latter were seized by the mandibles, curled themselves up in a quiescent attitude and permitted themselves to be borne without remonstrance to the nests of the slave-makers. On stationing myself at these nests I repeatedly saw a few of these deported individuals escaping and making for home. Often they had secured a larva or pupa in the galleries of the *subintegra* nest, where they had been released, and attempted to carry it home. It was surprising to see them timidly avoiding the great army of returning slave-makers by mounting the grass blades and nervously moving back over the heads of their foes. They were often detected, however, and compelled to drop their burdens, or were driven off into the grass where they wandered about disconsolately and as if they had completely lost their bearings. It would be of interest to know whether any of the deported workers remain in the *subintegra* nest and become a part of the mixed colony or are merely carried home in obedience to an impulse which prevents the slave-makers from returning empty-handed, or, more accurately speaking, with empty jaws.

The large number of *subintegra* forays which I witnessed before leaving South Harpswell convinced me that this ant, in the proper season or whenever the weather is propitious, must be almost constantly employed in plundering the nests of *glacialis* and *subsericea.* Hence there is nothing surprising about the size of its colonies and the number of its slaves.

In the light of these observations my former failure to find similar dulotic instincts in the young *subintegra* females while engaged in founding their colonies, called for further investigation. I therefore captured a number of females and performed two different sets of experiments, one similar to those described in my former paper and consisting in placing a female in a nest with a number of *glacialis* workers and their larvæ and pupæ, and another in which the female was confined with a diminute colony comprising the mother queen as well as the workers and brood of the slave species. The results of a considerable number of these experiments were fairly uniform and in all cases the behavior of the *subintegra* queen, to my surprise, was essentially like that of the *rubicunda* queens, which gave the first clue to the method employed by the slave-makers in establishing their formicaries. I subjoin a condensed statement of the results in both sets of experiments:

1. When the female *subintegra* was introduced into a nest with a small number of *glacialis* workers (3–12) and their brood, she was at once seized in the usual manner by her antennæ and legs. She always succeeded in freeing herself and soon became aggressive but at first merely seized the attacking workers in turn by their legs and antennæ as if to dissuade them from further hostilities. If they became more persistent her excitement increased and she no longer hesitated to kill them by piercing their heads, thoraces or abdomens with her mandibles. Sometimes her mere presence frightened the workers so that they scurried about the nest like so many sheep. Without waiting to dispose of all her persecutors, she began to collect the larvæ and pupæ and tuck them away in some corner or under a lump of earth. This she did with great precision and perseverance, interrupting her task only to punish or kill some bold worker that came up to snatch one of its own cocoons. By the following day she had killed all the *glacialis* workers, had brought all the brood together and was resting on it with open mandibles, alert and ready to pounce on any intruder. From time to time she left the cocoons and carefully explored the chamber in which she was confined as if to satisfy herself that there were no foes lurking in the background. The regularity of these exploring movements was similar to that described by Huber for the queens of the Brazilian *Atta*, while establishing their colonies and fungus gardens in their small earthen chambers. After the lapse of several days the *subintegra* queen could be surprised in the act of opening the cocoons and assisting the callow *glacialis* workers to hatch. And gradually the number of these increased till she was surrounded by a loyal colony of jet-black attendants, who now completed the work of divesting the remaining workers of their swaddling clothes, while the queen, like the old mother queens of adult colonies, became more timid and negatively heliotropic and sought refuge in corners whenever the nest was uncovered.

This was the course of events in several cases, but often the queen succumbed to the attacks of the workers within a few hours or days. Yet even in these cases she exhibited the same aggressive behavior and interest in the brood till she was overcome by her assailants. For some of the experiments the queens were artificially deälated, but even when introduced in the winged condition, they were soon deälated by the workers. In three of the experiments I used fecundated and deälated females found running on the ground, but their behavior and that of the *glacialis*, among whom they were placed, was essentially the same as when virgins were employed. In no case was a queen adopted by adult workers. These never showed any inclination to tolerate her, and if she survived their attacks she never permitted any of them to remain alive in the nest.

2. The second series of experiments was undertaken with a view to determining the behavior of the *subintegra* queen on entering a small *glacialis* colony possessing its own queen. One of several possible fates could be supposed to await this unfortunate insect: she might be driven away or killed by the *subintegra* queen; she might be tolerated and permitted to survive till the workers hatched from their cocoons and be destroyed by these members of her own species. The results obtained in six experiments were quite uniform and indicated that the *glacialis* queen shares the fate of her own workers. When the *subintegra* was attacked by the latter, on being placed in their midst, the *glacialis* queen showed no interest in the struggle, but on encountering the intruder fled in dismay to a corner of the nest, and the *subintegra* queen was so busy defending herself from the hostile workers that she ignored the frightened mother. After the workers had been dispatched, however, and the brood appropriated, the *glacialis* queen was often seen to approach the pile of larvæ and pupæ as if drawn to them by an irresistible longing, but she was again and again driven away by the *subintegra*. The latter made quick dashes at the black queen but did not grapple with her. But as in every experiment the *glacialis* was found dead on the day following the usurpation of the brood by the *subintegra*, I have no doubt that she shared the fate of her worker daughters.

I next attempted to secure the representation of *subintegra* queens in *glacialis* colonies by introducing queen cocoons of the former species, but these were always rejected or the pupæ were prematurely taken out of their cocoons and thrown on the refuse heap. Introducing cocoons of *glacialis* queens among the worker cocoons appropriated by the *subintegra* queen also led to no result as the insect simply threw them out and permitted them to die in a remote corner of the nest. It is therefore impossible to say how the host queen would be eventually suppressed if a *subintegra* queen happened to gain adoption in her colony. Among my published experiments on *rubicunda* (*loc. cit.*, p. 78) was one (No. 35) in which a female *subsericea* was reared and lived in a nest with a *rubicunda* queen and 175 *subsericea* workers. Both of the females lived peacefully side by side for two weeks, when the nest was abandoned, but I failed to record that during the last days of this period the host queen was repeatedly attacked and pulled about by her own workers. I remember wondering at this strange performance. Now that Santschi has shown that in nests of the North African *Monomorium salomonis* that are invaded by a queen of the parasitic *Wheeleriella santschii*,[1] the host queen is actually massacred by her own workers, my observation acquires significance and I am inclined to believe that it illustrates the method of eliminating the host queen not only in the rare cases in which *sanguinea* queens may be adopted in colonies of adult *fusca* workers and queen, but also when such colonies are invaded by temporary social parasites (*F. consocians, rufa, integra, truncicola, exsecta,* etc.).

IV. FORMICA SANGUINEA ASERVA FOREL.

My previous acquaintance with this boreal subspecies, of which a single slaveless colony was first found by Forel at Toronto, Canada, was confined to four colonies at Colebrook, Connecticut, and a few incomplete and unsatisfactory experiments with artificially deälated queens. In the vicinity of South Harpswell this form is as common as *subintegra* but prefers to nest in and under old spruce stumps and logs, and is much less frequently found in the open fields. Its colonies are often very large, a single one sometimes occupying every stump in a clearing and spreading over twenty or thirty nests. I have been able to study colonies of all sizes. These may be arranged in three groups representing as many stages of ontogenetic development.

1. July 7 I found at Ash Point a very small colony containing a deälated queen and a single callow worker of *aserva*, about 70 *glacialis* workers and about 200 larvæ and small cocoons. Nearly the entire colony was captured and placed in an artificial nest; only a few of the *glacialis* workers managed to escape into the grass. During the remainder of the month the cocoons hatched and all yielded small *aserva* workers. This colony was therefore in its second year, having been founded during the summer of 1907, and this must have been accomplished either by a number of adult *glacialis* adopting the *aserva* queen or by this queen appropriating *glacialis* pupæ. That the latter alternative is to be accepted will be shown presently.

2. Medium sized colonies presumably in their third and fourth years

---

[1] See Forel: Moeurs des fourmis parasites des genres Wheeleria et Bothriomyrmex. Rev. Suisse Zool., XIV, fasc. 1., 1906, pp. 51–69, and Santschi: Moeurs parasitiques temporaires des fourmis du genre Bothriomyrmex. Ann. Soc. Entom. France, LXXV, 1906, pp. 363–392.

were occasionally found. In these the *aserva* workers were large and very pugnacious and at least two to three times as numerous as the *glacialis* workers. Males and winged females were often present in these colonies during July.

3. Many much larger colonies were found in different localities, occupying several nests and comprising thousands of belligerent workers. Among these it was often impossible to find more than a few dozen *glacialis* workers and in some cases none was to be observed. Males and winged females were sometimes present, the former appearing first as in the *subintegra* colonies.

On clear, sunny days during the latter part of July I devoted much time to watching the *aserva* colonies but in no instance were any of the ants seen to make a foray. The nests, moreover, were often situated in the immediate vicinity of flourishing *glacialis* colonies which showed none of the signs, so often visible in colonies of this same ant when nesting near *subintegra* nests, of being harassed or of losing their brood.

A series of experiments performed with both artificially deälated and winged virgins, and with fecundated queens of *aserva*, introduced into nests containing several *glacialis* workers and their broods, gave essentially the same results as described for *F. rubicunda* and *subintegra*. The *aserva* queens were, however, fiercer than those of *subintegra* and did not stop to tweak the legs and antennæ of their assailants but killed them outright and appropriated the brood. The secreting and guarding of the brood and the assistance given to the hatching callows exhibited the same picture as in the other subspecies, and when the *aserva* queens were placed in small colonies containing a mother *glacialis*, the latter was also eventually killed or injured.

From these observations and experiments we are justified in concluding that, though the *aserva* queen founds her colony in the same manner as the queens of *rubicunda* and *subintegra*, the workers do not make forays. The small number of *glacialis* seen in old colonies are, therefore, the last survivors of the brood which was hatched under the guardianship of the young *aserva* queen when the colony was being founded. This is not surprising, for it is known that the workers of *fusca* may live several years and the largest *aserva* colonies are probably in many cases not more than five or six years old.

I am able to account for the discrepancy between my experiments on the founding of colonies by the *subintegra* and *aserva* queens at South Harpswell and those which I performed at Colebrook, Conn., only on the supposition that the queens in the latter locality were immature or weak. It is indeed probable that there is in the life of the *sanguinea* queen a 'psychological moment' which is necessary to the release of the catenary reflexes of colony formation, and that the individuals on which I experimented during the summer of 1905 either had not attained or had already passed this critical point in the maturation of their instincts.

V. REMARKS ON THE ONTOGENETIC AND PHYLOGENETIC DEVELOPMENT OF SLAVERY AND TEMPORARY SOCIAL PARASITISM.

Since my account of the American *F. rubicunda* was published, my method of experimentation has been applied to the typical European *sanguinea.* Wasmann[1] at once sought to discredit my work on the ground that I had employed only virgin queens, and that his own experiments with fecundated individuals indicated that the *sanguinea* colony is formed by adoption. Viehmeyer[2] repeated my experiments with the European *sanguinea* and obtained precisely the same results as I had described for *rubicunda.* Now Wasmann returns to the subject in a rather voluminous paper,[3] and relates a number of observations and experiments which have induced him to agree with Viehmeyer and myself.

It is naturally a source of no little gratification to me to find that at last the eminent Jesuit has not only confirmed my predictions of 1904,[4] by showing that the European *F. rufa, pratensis, truncicola* and *exsecta* are temporary parasites like the allied American forms, but has also accepted my views on the formation of colonies by the sanguinary ants so fully that there remains between us no dissension in regard to the facts. There is, indeed, an outstanding difference in interpretation, but this relates almost exclusively to a purely speculative matter, the phylogenetic origin and development of slavery. As the observations on *F. subintegra* and *aserva* above recorded have a bearing on this interpretation I may be pardoned for again returning to the discussion.

Wasmann is still desirous of deriving the dulotic from the adoptive method of colony formation as is shown by a tendency in many parts of his work to obliterate the boundaries between these two methods. It may be granted that such a procedure is more consonant with the fluently variable character of living phenomena, and also that the term adoption has been used rather loosely both by Wasmann and myself, but I nevertheless believe that the two processes are quite distinct genetically and that it is expedient and desirable to distinguish them carefully in all future investigations on the founding of colonies by queen ants. We have been using 'adoption' first, in a general sense, to designate the founding of colonies by queens of one species with the aid of workers of the same or an allied species. In this sense the term is equivalent to 'consociation' or 'affiliation' and is, of course, merely a brief description of the fact that mixed colonies of the same or of two or more species are formed. Second, the term 'adoption' is used in a special sense to designate the amicable reception and retention of a strange queen in the colony of an allied species (social parasitism, temporary and permanent). And third, the term is used in another special sense to designate the direption and appropriation of the brood of one species by an alien queen who is accepted and retained by the hatching workers (dulotic parasitism). Here it is obviously only a matter of words whether we say that the queen adopts a strange colony in a juvenile condition or is adopted by that colony when it has matured, since the pragmatic result is the same in both cases. In the general sense, above referred to, the term 'adoption' is merely a description of a condition which is the very basis of colonial organization in the social Hymenoptera; in each of the special senses, however, it designates a particular method of bringing about this condition when the ants concerned belong to different species.

---

[1] Die moderne Biologie und die Entwickelungstheorie. 3d edit. Freiburg i. Br., 1906, p. 402, Anm. 2.

[2] Zur Koloniegründung der parasitischen Ameisen. Biol. Centralbl. XXVIII, No. 1, Jan. 1, 1908, pp. 18–32.

[3] Weitere Beiträge zum sozialen Parasitismus und der Sklaverei bei den Ameisen. Biol. Centralbl., XXVIII, Nos. 8–13, 1908, pp. 257–271, 290–306, 321–333, 353–382, 417–441; 3 figg.

[4] A New Type of Social Parasitism among Ants. Bull. Amer. Mus. Nat. Hist., XX, Oct. 11, 1904, pp. 347–375.

Now the discrepancy between Wasmann's position and that of Viehmeyer and myself is this: Wasmann contends that phylogenetically dulotic arises out of temporary social parasitism and tends to return to social parasitism of the permanent type. Viehmeyer and I are perfectly willing to grant the degeneration of dulotic into permanent parasitism in cases like *Polyergus*, *Harpegoxenus* (*Tomognathus*) and *Strongylognathus*, but we are not convinced of its origin from temporary parasitism.

In order to understand Wasmann's position it will be necessary to review his facts. He has found that the workers of adult *F. truncicola* colonies, which are temporary parasites in their juvenile stage, will appropriate worker *fusca* pupæ placed in or near their nest and permit the hatching ants to survive as auxiliaries. He gave a *truncicola* colony a large number of pupæ belonging to the following species: 660 *F. fusca*, 100 *rufibarbis*, 100 *rufa*, 300 *pratensis*, 50 *exsecta*, 50 *sanguinea*, 50 *Camponotus ligniperdus* and 100 *Lasius niger*. The *Camponotus* and *Lasius* pupæ were at once rejected, the pupæ of *F. rufibarbis*, *sanguinea* and *exsecta* were retained, but not reared. The following were hatched and adopted: *F. fusca* (about $\frac{10}{11}$ of the total number), *pratensis* (about $\frac{2}{3}$), *rufa* (about $\frac{1}{2}$). He concludes from this and similar experiments performed with wild colonies that "*F. truncicola* even in its old and independent colonies preserves a pronounced *penchant* for rearing the pupæ of the very species of *Formica*, with whose aid its colonies are established." He reached the same conclusion as the result of experiments with *F. exsecta*, which he now finds, as I predicted, to be a temporary social parasite like *truncicola* and the long series of allied North American and European species of the *rufa* and *microgyna* groups. He failed, however, to find any such tendency in the typical *rufa* and *pratensis*, which are, nevertheless, temporary parasites of much the same character. The following quotation seems to contain the gist of Wasmann's present views on the relations of social parasitism to slavery: "We are unable to draw a hard and fast line between the founding of colonies by robbing the pupæ (pupillary parasitism of Santschi and Wheeler) and by adoption (tutelary parasitism of Santschi and Wheeler). Both types seem to occur and sometimes pass over into each other. In nature the union of these types may occur when the old *fusca*, that have fled with their brood on the invasion of a *sanguinea* queen, gradually return and associate themselves with the young workers that have hatched in the meantime from the captured pupæ. In this manner we can perhaps explain more satisfactorily the large number of auxiliaries in young *fusca* colonies than by the robbing of pupæ alone.

"My experiments also show several striking transitions between the colony founding of *rufa* and *sanguinea*. The *rufa* queen often defends herself violently from the assaults of the *fusca* and kills a number of her assailants. On the other hand she sometimes appears much interested in the worker cocoons of the *fusca*, collects and defends them and even prefers to remain with them rather than be adopted by the old workers. Nevertheless *F. rufa*, in a state of nature, is not a slave-holding ant, and when she employs alien auxiliaries in founding her colonies, this is usually accomplished by adoption and not by robbing the pupæ.

"Indeed, the analogies between the colony founding of *rufa* and *sanguinea* deserve careful consideration in connection with the question under discussion. In both species colonies are frequently formed by detachment ('Zweigkolonienbildung') and just as the queen of the former species is readily accepted by workers of her own species, and with them establishes a new colony, so also in the case of *sanguinea*. Just as the former, if she is unable to find workers of her own species with which to found a colony, turns to alien auxiliaries (social parasitism), so also the latter. As in the former so also in the latter two forms of parasitic colony-founding occur: by adoption on the part of adult *fusca* and by appropriation of the brood. In *rufa*, however, the parasitic method is still facultative, in *sanguinea* it is more obligatory. We see, moreover, that of the two tendencies which diverge from the facultative parasitic founding of colonies, one, leading to the adoption colonies, has become obligatory in *truncicola,* while the other, leading to the predatory colonies, is more or less obligatory in its development. There exist, therefore, manifold transitions between the facultative and obligatory types of parasitic colony formation on the one hand, and between the two types of parasitic colony formation (by adoption and the robbing of pupæ) on the other. At any rate, if we are to form a conception of the phylogenetic origin of the regular types of adoption colonies on the one hand and of predatory colonies on the other, we must start with a species of *Formica* in which the parasitic method was facultative, one in which there already existed the possibility of developing both forms of parasitic colony formation.

"Accordingly, we may say that the origin of slavery in *F. sanguinea* is not to be sought in a '*truncicola*-like form,' but rather in a '*rufa*-like form'; for in *truncicola* the parasitic founding of colonies by adoption has already become obligatory. On the other hand the inclination of *F. truncicola* to select for rearing, among different pupæ, the very ones (*fusca*) belonging to its former auxiliary species, makes it possible to understand why the slave-makers (like *sanguinea*) also continue to rear the pupæ of the original auxiliaries with which their colony was founded, and do not at once devour them as they do with the pupæ of strange species. Hence the results derived from a study of *truncicola* retain their decisive importance in any hypothetical explanation of the origin of slavery. One may also designate the *truncicola*-stage as a preliminary to the *sanguinea* stage to the extent that the former species produces only temporary mixed colonies of three years duration, while the latter, on the contrary (at least in the case of the typical European *sanguinea*), produces permanently mixed colonies; for there can be no doubt that the permanent are to be derived from the temporary mixed colonies. But this derivation must proceed from temporary mixed colonies in which adoption has not yet become so obligatory as it is in *truncicola*, but in which the possibility of founding colonies with robbed pupæ is still open (as in *rufa*) and capable of a gradual development."

With most of this passage I agree, but there are in its last paragraphs certain statements to which exception may be taken. I am unable to find in any of the facts hitherto published by Wasmann on *truncicola*, a sufficient basis for conclusions concerning the phylogenetic origin and development of slavery. *F. truncicola*, according to his account, behaves like any other temporary parasite, except that its pure adult colonies will rear the pupæ of *fusca.* It is not a little strange that *F. consocians*, which on account of its much smaller queens, may be supposed to be in an even more advanced stage of temporary parasitism, will not, as I have shown (The Founding of Colonies, etc., *loc. cit.*, p. 61) rear the auxiliary *incerta* in adult colonies.

In the case of *truncicola* and *exsecta* Wasmann claims that the rearing of auxiliaries is due to a harking back, so to speak, to the mixed juvenile stage of the formicary. But why do not *consocians* and *rufa* behave in a similar manner? In the above described experiment, in which he gave the *truncicola* colony the cocoons of a variety of *Formicæ* and other ants, it is seen that the number of *fusca* (660) is greater than the sum total of all the others (600). Is it not possible that these proportions were such as to develop a tendency or habit to prefer the *fusca*, quite irrespective of any inherited reminiscence? And is it not probable that the greater survival of *fusca* in an alien living environment may be due to the greater vigor of its brood? That *fusca* is a very hardy species in all its ontogenetic stages is shown by the great abundance of its colonies, notwithstanding their exploitation by a whole series of parasitic *Formicæ* and *Polyergi*, its wide distribution and its occurrence in the most diverse conditions of soil, moisture, temperature and altitude. At any rate, the experiment to be conclusive, should have been made with equal numbers of pupæ of the various species of *Formica*, *Lasius*, and *Camponotus*. But even granting Wasmann's interpretation of *truncicola's* motives for rearing *fusca*, what bearing does this have on the slave-making colonies more than is already indicated in the founding and development of these colonies themselves? That the workers of *sanguinea*, *rubicunda* and *subintegra* continue the tactics of their young queens and rob the *fusca* pupæ, has its *raison d'être* in the behavior of the queens and does not need to be explained by reference to *truncicola* or any other temporary parasites. What requires explanation, however, is the fact that the *aserva* workers, if my observations are correct, do not make slaves, although their queens behave like the queens of *subintegra, rubicunda* and the typical *sanguinea*. It may be true, as Wasmann maintains, that *sanguinea* queens are sometimes adopted by adult alien *fusca* workers, but I have never seen anything to suggest this in my numerous experiments on the three American sub-species. If it occurs in a state of nature it must be very exceptional. But even if its frequent occurrence be granted, it does not throw any light on the origin of dulosis. This still remains a distinct phenomenon which may have been grafted on to an incipient form of temporary social parasitism, or develop within its sphere but is not, properly speaking, a stage in its development.

Wasmann's observations on *rufa* are of unusual interest because they seem to indicate that we have in this species two tendencies, coëxisting Janus-faced, so to speak, in the directions of temporary social and dulotic parasitism. In this species both tendencies are probably useful, according to the benign or belligerent attitude assumed by the workers of her own or the alien species among which the queen is endeavoring to establish herself.

F. aserva perhaps represents the next stage in the phylogenetic development of dulosis, one in which the dulotic tendency has supplanted that of adoption, but without being transmissible by the queen to her worker offspring. The European *sanguinea* and the American *rubicunda* would represent a somewhat more advanced stage, with the workers becoming dulotic, but without a very strong tendency to make forays; and lastly the subspecies *subintegra*, with its very numerous slaves and frequent forays, would represent the culmination of dulosis in the sanguinary series. That phyletic development has followed some such course is suggested by the small stature of all three phases in *subintegra*, which in this respect is further removed from *rufa* than any of the other forms of *sanguinea*, including the type.

There are, however, other conditions which lead me to believe that the phylogenetic origin of slavery may not be so clear as I have just indicated:

1. It is not improbable that the young queens of many ants that are in no sense temporary social parasites, will nevertheless usurp and guard the brood of other species with which they may come in conflict. In other words, the tendencies of the *sanguinea* queen may be very general among the *Formicidæ* although this has not been established by experiment. I had hoped to investigate this matter during the past summer, but the work on *subintegra* and *aserva*, together with a faunistic study of the Casco Bay ants, consumed all my time. Experiments must be performed, however, before it can be positively stated that the dulotic instincts are necessarily associated with those of adoption, as they seem to be in *F. rufa*.

2. The behavior of the young *sanguinea* queen is evidently a mixture of predatory and philoprogenitive reactions. Is it not possible that the former, which are the more characteristic, have their phyletic roots in the ancient predatory habits of the solitary wasp-like or mutillid-like ancestors from which, by common consent, the Formicidæ have been descended? These ancestors, like the existing solitary wasps, probably provisioned their nests with insect prey. Certainly the behavior of the young *sanguinea* queen while collecting and defending the brood which she has captured, is very suggestive. If she deposited her eggs immediately after capturing the brood and her larvæ fed directly on this brood after the manner of Ponerine larvæ, we should have a condition like that seen in existing solitary wasps, excepting that these do not feed on the larvæ of allied wasps, but on caterpillars, spiders, crickets, flies, aphids, etc. The *sanguinea* larvæ do not feed on the *fusca* brood directly, but both they and the queen are fed by the adult workers, so that in this case we have an example of the transition from predatism to parasitism.

3. This transition is very instructive because zoologists have long been of the opinion that parasitism usually arises from predatism, that it is, in

fact, merely a refined (in the sense of the German "raffinirt") method of predatism. In the animal kingdom, at least, there are many cases which point to this as the regular phyletic sequence, but it would be difficult to cite a case in which parasitism has given rise to predatism, and this is, if I am not mistaken, the sequence postulated by Wasmann in his interpretation of dulosis.[1]

In my opinion we may seek the origin of dulosis, even of the *sanguinea* and *Polyergus* types, in such predatory habits as are still exhibited, albeit in a degenerate and specialized form, among the thief ants (*Solenopsis fugax*, *molesta*, etc.), which live in the gallery walls of the nests of many different *Formicæ* and prey on their larvæ and pupæ. Viehmeyer has, in fact, given good reasons for supposing that the dulotic habits of *Harpegoxenus* (*Tomognathus*) have had such an origin, and the same is probably true of *Strongylognathus*, in which we also have the mature females of parasite and host coëxisting in the same formicary. In both of these genera, however, the dulotic instincts have degenerated secondarily. Dulosis, on this supposition, would be either the continuation or revival of an ancient predatory habit, merging into and modified by the general adoptive instincts. This interpretation would also account for the predatory habits of the worker *sanguinea*, which have been emphasized by Forel, Darwin and myself, and finally also by Wasmann, in a passage in which he admits that the inclination of the workers to rob pupæ has its foundation largely in the "karnivore Ernährungsweise" of *sanguinea*. In this connection it is interesting to note that the annual dulotic forays of *sanguinea* do not begin till immediately after the marriage flight of the males and females and hence at the very time when the latter are founding their colonies by an activity essentially like that of the workers. This simultaneity of impulse in the workers and young queens, like the migratory instincts of many animals and the marriage flights of the ants themselves, probably depends on meteorological conditions.

Polyergus presents an interesting problem for future investigation, as Emery has shown in a recent paper.[2] Forel, Wasmann and Viehmeyer concluded from their experiments that young queens of *P. rufescens* are adopted rather readily by strange *fusca* and *rufibarbis* workers. I found that the young queen of our American *P. lucidus* is not readily adopted but received with marked hostility and usually killed by strange workers of the slave species, *F. incerta*, and that she shows no interest in the brood. Emery has performed similar experiments with *rufescens* with precisely the same results. Concerning the probable method employed by this ant in establishing its formicaries, he says:

---

[1] In the plant kingdom parasitism seems to proceed from saprophytism and there are probably among animals (*e. g.*, among myrmecophiles) several cases in which scavengers have developed into parasites.

[2] Osservazioni ed Esperimenti sulla Formica Amazzone. Rendic. Accad. Sci. Ist. Bologna, Sess. Feb. 1908, pp. 49–62.

"Huber found that the workers of *Polyergus* do not begin their forays till after *F. fusca* and *rufibarbis* have completed the education of their young males and females. This observation is accurate only in part, as Forel has observed. The fact is that *F. fusca* and its subspecies are more precocious than *Polyergus* by about a month.

"The female *F. fusca* is therefore capable of founding a nest before the *Polyergus* can emigrate from their natal formicary. A female *F. fusca* which Wasmann captured in April, 1886, had already produced worker pupæ by the middle of June. In September, 1894, Wasmann found a nascent formicary of *rufibarbis*, containing in addition to the queen, three callow workers.

"Might not a female *Polyergus* occupy one of these nascent nests containing only the female of the host species and her still immature offspring?

"Another hypothesis seems to me more probable, namely, that the *Polyergus* female selects a colony in its second year, containing a *fusca* female surrounded by workers, still few in number, with abundant eggs, larvæ and pupæ, assassinates the mother and usurps her position."

From the fact that in artificial nests the female *Polyergus* remains indifferent to the brood, Emery concludes that she "seeks only adoption and something mysterious besides (ancora qualcosa di misterioso)." This mysterious something, he believes, may be the eggs of its host, and he cites in support of this suggestion some unpublished observations of Santschi, who found that the queen of the temporary parasite *Bothriomyrmex medionalis*, after killing the queen of her host (*Tapinoma erraticum*), remained several months without laying, and that it was only after she had been fed with the eggs from another *Tapinoma* nest that she began to lay. In this connection Emery cites an observation of Wasmann, who found *Polyergus* workers licking up the juices of larvæ and eggs which they had perforated with their sickle-shaped mandibles. I may add that I have made similar observations on *P. lucidus* workers in artificial nests. There is no doubt that the workers occasionally eat the eggs and it is quite probable that Emery, with his usual perspicacity, has suggested an interesting matter for future experimentation. His supposition, if it proves to be correct, would support my views on the predatory significance and origin of dulosis.[1]

---

[1] Emery confirms Forel's account of the participation of the young deälated females of *P. rufescens* in the forays of the workers. He believes that these females mate with the males in the parental nest and that the same is true of the peculiar ergatoid females which occur rather frequently in colonies of the European amazon. He even doubts whether copulation takes place in the air as in other species, although both Huber and Forel have witnessed marriage flights of *Polyergus*. Burrill (A Slave-making Foray of the Shining Amazon. Journ. New York

In conclusion I append the following notes on some imperfectly known species which are, in all probability, temporary social parasites:

1. *Lasius fuliginosus* Latr.— De Lannoy[1] has recently found a mixed colony of *L. mixtus* and *fuliginosus*, which Emery[2] is probably right in regarding as indicating that *L. fuliginosus* founds its colonies by temporary parasitism on *L. mixtus*. He calls attention to the fact that "*L. fuliginosus* differs from most of its congeners in having females that are only a little larger than its workers. *L. carniolicus* and, to some extent, also *L. bicornis* are in the same condition. The great majority of species of the genus *Lasius*, on the contrary, have females that are much larger than the workers; they have large rotund gasters, full of stored fat, capable of nourishing the mother during her long fast and while engaged in establishing a family and compelled to subsist exclusively on the resources of her own body." We are justified in inferring that the microgynous and macrogynous species of *Lasius* bear the same relation to each other as is borne by the microgynous and mesogynous species of *Formica* to the various macrogynous varieties and subspecies of *F. fusca* and *pallidefulva*.

2. *Formica exsecta suecica* Adlerz.— Wasmann, in his latest paper, calls attention to the small size of the queens of *F. exsecta* and its subspecies *pressilabris*, a fact which impressed me while I was studying these ants in Switzerland and Germany during the summer of 1907. In his 'Fourmis de la Suisse' Forel long ago mentioned several small mixed colonies of *exsecta-fusca* and *exsecta-pressilabris fusca*, which I pointed to as evidence of temporary social parasitism. Early in July, 1907, I found a small col-

---

Entom. Soc., XVI, Sept. 1908) has recently described a feeble marriage flight of our American *lucidus*, and August 20, 1903, I saw a large and very typical flight of this ant near Colorado Springs. Burrill saw a male attempting to mate with a female, and I am unable to believe that copulation does not occur during flights like the one I witnessed. It is true, nevertheless, that the mature males and females linger long in the parental formicaries. I have noticed this in a beautiful *lucidus* colony which I have had under observation for the past five years near Bronxville, N. Y. During four years this colony produced numbers of males and females, both winged and ergatoid, and the winged females lingered for weeks in the nest without deälation. The first week of the past April I found the whole community with its larvæ and mother queen enjoying the spring warmth in the superficial galleries just under the large flat stone with which I had covered the nest in September, 1903. I captured the queen and part of the colony and transferred them to an artificial nest. August 9 I again visited the nest, and to my surprise, found it teeming with several hundred mature males clinging to the lower surface of the stone, but with no winged or deälated females. Besides the males I found only a single large ergatoid female, several dozen workers and slaves and half a dozen cocoons enclosing nearly mature male pupæ. Without doubt, the ergatoid had usurped the rôle of the mother queen and, being unfertilized, had produced only male offspring. The comparatively small number of slaves had been able to rear an enormous number of these little creatures although the absence of *incerta* pupæ in the nest indicated that the *Polyergus* workers had made no forays during the past summer.

I find in one of my note-books an observation which is very significant in connection with the foregoing quotation from Emery. August 12, 1903, I discovered under a small stone near Colorado Springs, Colorado, an incipient mixed colony of *P. breviceps* and *F. fusca* var. *argentata*. It consisted of a fine deälated queen and 7 or 8 diminutive workers (micrergates) of the former species, a few small cocoons, apparently also belonging to the *Polyergus*, and about a dozen small *argentata* workers. This was doubtless a colony in its second year, strictly comparable to second year colonies of *sanguinea* and the temporary social parasites.

[1] Notes sur le Lasius niger et le Lasius fuliginosus. Ann. Soc. Ent. Belg., LII, 1908, p. 47–53.

[2] Remarques sur les Observations de M. de Lannoy touchant l'existence de Lasius mixtus dans les fourmilières de Lasius fuliginosus. Ann. Soc. Ent. Belg., LII, 1908, pp. 182–183.

ony of *exsecta-pressilabris-fusca* on the slopes of Monte Generoso in Canton Ticino, and Wasmann has just described a small *exsecta-fusca* colony which he discovered in Luxemburg during October, 1906. Adlerz has described as *suecica* a Swedish subspecies of *exsecta.* A type female of this form received from Professor Forel proves to be even smaller than that of *exsecta.* The latter measures 6.5–7 mm., whereas the former is no larger than the largest workers and measures only 5 mm. *F. suecica* is therefore the most microgynous of all the European *Formicæ.* Its queen is, in fact, as diminutive as those of the North American *microgyna, impexa, nepticula* and *nevadensis,* and must have very pronounced parasitic habits. As the only American species of the *exsecta* group, *exsectoides* and *ulkei,* have queens as large as those of *F. rufa* and *truncicola,* we have in the *exsecta* group a series of micro-, meso- and macrogynous females strictly comparable to the series which I have established for the *rufa* group. It is interesting to note that on both continents the microgynous species and subspecies are decidedly boreal or monticolous, whereas the meso- and macrogynous forms often extend down into the lowlands and have a more southerly distribution.

3. *Formica dakotensis* Emery.— The taxonomy of this species needs some rectification. Emery first described the workers of the typical form from Hill City, South Dakota.[1] In the same paper (p. 663) he described a small female ant from Wisconsin as var.? *specularis,* denoting by the query that the insect might prove to be either a variety of *F. fusca subpolita* Mayr or an independent subspecies of *fusca.* Wasmann afterwards sent females, males and workers of this same *specularis,* collected by Muckermann at Prairie du Chien, Wis., to Forel, who recognized them as a form of *dakotensis* but described them as a new variety under the name of *wasmanni.*[2] Emery wrote me some time ago that he had compared some of the females with his type of *specularis* and found them to be identical. *F. wasmanni* is therefore merely a synonym. Like Forel I have been guilty of making a synonym in redescribing specimens of the typical *dakotensis* from Colorado, as *F. montigena.*[3] Examination of one of Emery's types in Forel's collection convinced me of this error.

At Prairie du Chien Muckermann found several mixed colonies of *F. dakotensis* var. *specularis* and *F. subsericea* and other larger colonies containing *specularis* only. Wasmann, although he had never seen this variety in the field but knew its habits only from Muckermann's notes, jumped to the conclusion that it is probably incipiently dulotic or, at any rate, represents a stage midway between *truncicola* and *sanguinea.*[4] And, notwithstanding my comments on this prognostication, he seems still to adhere to it in a table published in his latest paper.[1] Now, although, like Wasmann, I have never studied the var. *specularis* in the living condition, I have nevertheless become well acquainted with the typical *dakotensis*. This ant is not uncommon in certain localities in Colorado at altitudes above 6000 ft. (Pike's Peak, Ute Pass, Florissant and Buena Vista). Its adult colonies are very much like those of *truncicola* and *consocians* but more populous. They sometimes occupy several nests near one another, under stones, about the roots of bushes and in old stumps. During the summer of 1903 I found two juvenile mixed colonies of this ant with *F. incerta*, and this discovery, combined with the fact that the females are very small, shows that the species must be a temporary social parasite. As the adult colonies often occur in the very midst of *incerta* and *fusca* (var. *argentata*) colonies, without exhibiting any tendency to mix with them, I fail to perceive the slightest suggestion of dulosis. The presumption is therefore very strong in favor of the same condition obtaining in the var. *specularis*. At any rate we should drop all further allusions to incipient dulosis in this ant till it has been studied by some one thoroughly familiar with the subject under discussion.

---

[1] Beiträge zur Kenntniss der nordamerikanischen Ameisenfauna. Zool. Jahrb., Abth. f. Syst., VII, 1893, p. 652.

[2] Fourmis de British Columbia. Ann. Soc. Ent. Belg., XLVIII, 1904, p. 153, nota.

[3] A New Type of Social Parasitism, etc., *loc. cit.*, pp. 374, 375.

[4] Ursprung und Entwickelung der Sklaverei bei den Ameisen. Biol. Centralbl., 1905, p. 277 et seq.

4. *Stenamma* (*Aphænogaster*) *mariæ* Forel.— In his original description of the worker of this species, Forel[2] called attention to its close resemblance to the worker of *S.* (*A.*) *tennesseense* Mayr, an ant which I have given good reasons for regarding as a temporary social parasite on *S.* (*A.*) *fulvum*. According to my experience, *S. mariæ* is a rare species confined to the Atlantic States. It has been taken in Connecticut, New Jersey, North Carolina and Florida. Sept. 8, 1901, I captured a winged female running in the grass of a door-yard at Colebrook, Connecticut, and I have since received a deälated specimen taken by Mr. Wm. Beutenmüller in the Black Mts. of North Carolina. Both of these females are remarkable on account of their small stature (4.5 mm.) which does not exceed that of the worker. In this respect it closely resembles the female of *tennesseense* and contrasts with the large females of all our other North American species of *Aphænogaster*. But although the epinotal spines are large and robust, they are not so enormously developed and flattened as is *tennesseense*, and the head, thorax and pedicel are rugose and much less shining. The body and appendages are reddish brown, with more yellowish coxæ and tarsi; the wings are slightly infuscated, with pale veins and brown stigma. I believe there can be little doubt that this species is, like *tennesseense*, a temporary parasite on one or more of our numerous varieties of *S. fulvum*. Owing to the

---

[1] Weitere Beiträge, etc., *loc. cit.*, p. 430.

[2] Espèces Nouvelles de Fourmis Américaines. Compt. R. Soc. Entom. Belg., Séance du 6. Fév. 1886, p. 4.

close agreement in size, color and form between these two species, however, it will require extremely close observation to detect a mixture of their colonies in the field.

5. *Oxygyne.*— Forel has assigned to a special subgenus, *Oxygyne*, an interesting series of *Cremastogaster* species (*emmæ, ebenina, soror, travancorensis, dalyi, aberrans, ranavalonæ, paulinæ, agnetis, daisyi, marthæ* and *depressa*) from Madagascar, India and the Malayan region, because they have unusually small, glabrous females, with falcate, pointed or very oblique mandibles, abbreviated frontal carinæ and sometimes very strong epinotal spines and a robust abdominal pedicel.[1] The workers of these forms are, however, essentially like those of the ordinary macrogynous species of *Cremastogaster.* In one species of *Oxygyne* (*ranavalonæ*), according to Emery,[2] the mother queen has the gaster enormously enlarged and subspherical as in the old mother queens of the permanently parasitic *Anergates atratulus* of Europe. Forel suggests that the structural peculiarities of the *Oxygyne* females may be correlated with peculiarities of habit. Comparison of a series of these insects, kindly presented to me by the eminent myrmecologist, with the microgynes of *Formica,* and especially with those of *Aphænogaster tennesseensis* and *mariæ* leaves no doubt in my mind that they are temporary parasites on other species of *Cremastogaster.* Their sickle-shaped mandibles, so much like those of *Polyergus* and *Strongylognathus,* point to a method of assassinating the host queen similar to that employed by *Bothriomyrmex.* At any rate, such a supposition would constitute a good working hypothesis in carrying on further researches on the species of *Oxygyne.* In this case, also, extremely close observation in the field will be required to detect the existence of mixed colonies.

The foregoing notes suggest that the results hitherto obtained in the study of dulosis and temporary social parasitism are only a beginning in a subject of extraordinary interest. Although at present this interest is mainly theoretical, it is not improbable that the results already obtained may be capable of some practical application as soon as we have acquired a more accurate knowledge of the economic status, especially in forestry, of some of our more abundant ants, such as *F. rufa* of Europe and *exsectoides, integra* and their allies in the United States. If these insects are really as useful in destroying forest pests as some authors have maintained, their colonies may, perhaps, be greatly increased by an adroit introduction of their temporary hosts (*F. fusca* and *subsericea*) in certain regions. It is probable, however, that taking advantage of the tendency of most of these ants to form colonies by detachment or budding may lead to the same results. Field study of the Formicidæ is certainly becoming much more interesting and precise through our increasing knowledge of dulosis and temporary social parasitism, since every ant colony examined no longer represents to the observer merely a meaningless aggregate of individuals, but a definite stage in the life-cycle of a colonial organism. Thus the myrmecologist is prompted to attack a host of fascinating problems suggested by the origin, development and decline, both onto- and phylogenetic, of a living community and the instinctive processes involved in the numerical regulation of its polymorphic components.

---

[1] These species are described in the following papers: Les Formicides in Grandidier's Histoire Physique, Naturelle et Politique de Madagascar. 28 fasc. 1891, 280 pp.; 7 pll.; Nouvelles Espèces des Formicides de Madagascar (Recoltées par M. Sikora). Ann. Soc. Entom. Belg., XXXVI, 1892, pp. 516–536; Les Formicides de l'Empire des Indes et de Ceylan. Journ. Bombay Nat. Hist. Soc., VII, VIII, IX, XIII, XIV, 1892–1902; Myrmicinæ Nouveaux de l'Inde et de Ceylan. Rev. Suisse Zool., X, 1902, pp. 165–249.

[2] Descriptions de deux Fourmis. Bull. Soc. Entom. France, 1897, pp. 12–14, 2 figg.

59.9(728)

Article XXXIV.— MAMMALS FROM NICARAGUA.

By J. A. Allen.

During the last two years the Museum has received several collections of birds and mammals from Nicaragua, made by Mr. William B. Richardson, who for many years was in the employ of Messrs. Salvin and Godman as an ornithological collector in Mexico and Central America. The mammals thus far received comprise about 400 specimens, representing nearly 60 species, of which about one-fourth appear to be undescribed. This is perhaps not surprising, in view of the fact that very few mammals have been previously received from Nicaragua.

The most important of Mr. Richardson's discoveries are a new and very distinct species of *Bassaricyon*, and a new species of spiney rat, allied to the Ecuadorian *Echimys gymnurus* Thomas, and representing a hitherto unrecognized genus. The collection contains also several other species which are quite different from any previously known.

Mr. Richardson's collecting trips have covered a wide extent of country. From his home at Matagalpa, in the central part of Nicaragua, he visited the highlands to the northward and northwestward, and also the Pacific coast; eastward his explorations extended from Lake Nicaragua to the vicinity of the Atlantic coast. The principal points at which collections were made are as follows:

Matagalpa, altitude about 3000 feet.
San Rafael del Norte, altitude about 5000 feet.
Ocotal, altitude about 4500 feet.
Chinandega, on the Pacific slope, about 700 feet.
Chontales, lowlands east of Lake Nicaragua, altitude about 500 to 1000 feet.
Tuma and Lavala, east of Matagalpa, on the Atlantic slope, below 1000 feet.
Rio Grande, south of Tuma, and at somewhat lower altitude.

Prior to his present engagement Mr. Richardson had given very little attention to mammals, and hence has been somewhat handicapped in his work by lack of experience, yet his collection is a most valuable one and adds greatly to our knowledge of the mammal fauna of this part of Central America. Unfortunately quite a number of the skulls of some of the smaller species were accidentally lost, but future shipments will probably contain additional specimens of most of these species. Later shipments will be made the basis of a supplemental paper.

I am greatly indebted to Dr. M. W. Lyon, Jr., Assistant Curator, Division of Mammals, United States National Museum, for the use of important specimens for examination in the present connection, including the type of the genus *Bassaricyon*.

1. **Marmosa murina** (*Linnæus*). One specimen, San Rafael del Norte, April 11, 1907.

2. **Marmosa murina mexicana** *Merriam*. One specimen, Volcan de Chinandega, May 9, 1907.

3. **Caluromys laniger pallidus** *Thomas*. One specimen, adult male, Matagalpa, April 30, 1906.

4. **Metachirus fuscogriseus** *Allen*. Six specimens (5 ♀, 1 ♂): Matagalpa, Dec. 12, 1906, Jan. 8 and Nov. 17, 1907; San Rafael del Norte, April 16; Lavala, Oct. 6; Tuma, Nov. 26, 1907.

5. **Metachirus nudicaudatus colombianus** *Allen*. One specimen, male, not quite adult (last molar just in place), Chontales, Feb. 27, 1908.

Very closely resembles the type of this subspecies; but the top of the head and nape are blacker, and the general coloration above is slightly darker. Further material may show that the forms from the two regions are subspecifically separable.

6. **Didelphis mesamericana tabascensis** *Allen*. Six specimens — four adult (3 ♂, 1 ♀) and two about one-fifth grown, taken at Matagalpa, Jan. 8, 25, and 28, and Sept. 14 and 17, and at Lavala, Oct. 6, 1907. Five are in the gray phase and one in the black phase. The two young ones are about the same age, but one was taken Jan. 8, and the other Oct. 6.

7. **Cholœpus hoffmanni** *Peters*. Two specimens, a young male and an adult female, Matagalpa, Jan. 2, 1908.

8. **Bradypus griseus** (*Gray*). Two specimens, an adult female and a young female about one fourth grown, Chontales, Feb. 20, 1908; said by the collector to be mother and young.

The adult has a long black dorsal stripe, extending from the front of the shoulders to the middle of the back, flanked on either side by a narrow band of dull orange, which fades out laterally into a broader band of yellowish white. The young specimen has a short dull black dorsal stripe of soft black hair, shorter than in the adult, and not bordered by orange and yellowish white as in the adult. The young specimen is apparently still in first pelage, with the general color above dull cinnamon brown, instead of gray brown varied with white as in the adult.

The name *griseus* Gray is adopted provisionally, as the description and type locality are fairly pertinent.

9. **Cyclopes dorsalis** (*Gray*). One specimen, male, Rio Grande, April 7, 1908.

10. **Tamandua tetradactyla chiriquensis** *Allen*. One specimen, adult male, Ocotal, May 7, 1908.

11. **Tatu novemcinctus** (*Linnæus*). Two specimens, an adult male, Lavala, Oct. 19, 1907, and a younger specimen (label lost).

12. **Mazama tema** *Rafinesque*. Five specimens, an adult and two young males and two adult females, all taken at Tuma, Nov. 28–Dec. 8, 1907.

13. **Lepus floridanus chiapensis** *Nelson*. Three specimens: Leon, May 1, 1907; Chontales, Feb. 13, 1908; Ocotal, May 9, 1908.

These specimens differ from *L. f. aztecus* in the same manner as *chiapensis* is said to differ, but the dorsal surface is apparently more heavily washed with black than in *chiapensis*.

14. **Lepus gabbi tumacus** subsp. nov.

Type, No. 28409, adult ♂, Tuma, Nicaragua, Dec. 2, 1907; W. B. Richardson. Similar in size and cranial characters to *L. gabbi*, but coloration much deeper throughout; rufous of feet and limbs much more intense, and soles of feet much darker; ears darker and whole dorsal surface much more heavily varied with black, which is the predominant color of the whole dorsal area.

Represented by two specimens, the type, from Tuma, and another specimen from Ocotal, May 11, 1908. Both are adult males, and the collector's measurements are respectively as follows: total length, 360 and 340 mm.; hind foot, 68 and 70. Skulls, occipitonasal length, 69 (type), 66; zygomatic breadth, 32 (type), 31.6.

15. **Dasyprocta punctata** *Gray*. Four specimens: Matagalpa, May 14, male, and Sept. 26, juv., 1907; Lavala, male and female, Oct. 7 and 19, 1907.

16. **Coendu mexicanus** (*Kerr*). Three specimens: male, Volcan de Chinandega, May 10, 1907; female, Chontales, Feb. 18; female, Ocotal, May 1, 1908. The collector's measurements are

28334	♂	Total length,	790;	tail vertebræ,	370;	hind foot,	70
28485	♀	" "	680;	" "	300;	" "	60
28484	♀	" "	870;	" "	400;	" "	80

17. **Proechimys centralis** (*Thomas*). Twelve specimens: Rio Grande, March 20–April 4, 1908.

Hoplomys[1] gen. nov.

Type, *Hoplomys truei* sp. nov.

External characters in general as in *Proechimys*, but the spines much coarser and stronger. Molariform teeth with four transverse furrows instead of three as in *Proechimys*, deeper and longer, and those of the maxillary teeth much more oblique. (Figs. 1–4.)

---

[1] **ὅπλα**, arms, armor, **μῦς**, mouse; in allusion to the spiney covering.

This genus is characterized externally by the abundance and strength of the spines, which occupy nearly the whole of the dorsum and nearly conceal the underlying fur. The enamel pattern of the molariform teeth presents four strong, deep, oblique furrows instead of three short, shallow, transverse furrows as in *Proechimys*; the same differences characterize the lower molariform series, except that m_3 has only three furrows instead of four, as in the other teeth. These differences are well shown in the accompanying figures.

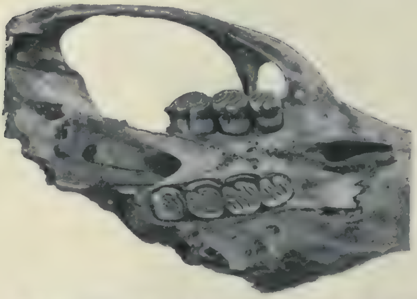


Fig. 1. *Hoplomys truei*. Type. No. 28367, ♂ ad. The last molar only slightly worn. $\frac{2}{1}$.

Echimys gymnurus Thomas is to be referred to this genus, and probably also *Echimys subspinosus* Tomes, both from Ecuador.

18. **Hoplomys truei** sp. nov.

Echimys centralis Allen, Bull. Am. Mus. Nat. Hist., IX, 1897, 42, Costa Rica (not of Thomas, 1896).

Type, No. 28367, ♂ ad., Lavala, Matagalpa Province, Nicaragua, Oct. 5, 1907.

General color of upper parts blackish varied with pale rusty brown; flanks grayish brown; whole ventral area pure white; forelimbs dusky grayish brown, the toes lighter; hind feet buffy white, more or less edged and mottled with dusky brown; soles of all the feet blackish brown; ears nearly naked, dark brown passing into blackish apically; tail wholly naked and coarsely scaled, grayish brown above, whitish below. Head and body, 380 (type) and 400 mm.; tail, 170 (type) and 140; hind foot 50 (type) and 45 (collector's measurements); hind foot, with claw (in dry skin), 53 (type) and 51. Skull (type), occipito-nasal length, 55; zygomatic breadth, 27; mastoid breadth, 21; length of nasals, 20, upper molariform series, 10; lower, 10.5.

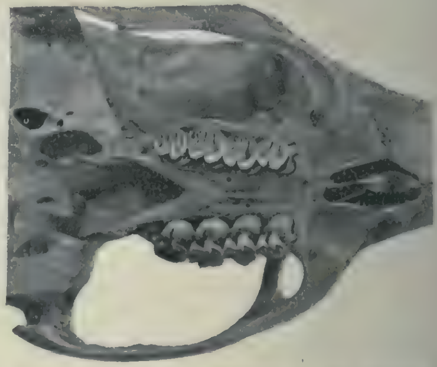


Fig. 2. *Proechimys trinitatis.* Type species of the genus *Procchimys* and type skull of the species. No. 6018, ♀ ad.

The teeth are slightly more worn than in the skull of *Hoplomys* shown in Fig. 1, but the attrition has not changed the pattern of the crown surface of the teeth. $\frac{2}{1}$.

This species closely resembles in coloration *Echimys semispinosus* Tomes,[1] from "Ecuador" (exact locality not known,[2] but probably from the coast). It differs from it in the spines not being "confined to the middle of the back"; neither are they "short and flexible," but long and very rigid. Neither is the tail "pretty evenly sprinkled with shortish hairs," but is entirely naked, the scales coarse, smooth and conspicuous. The skull as figured bears a close general resemblance to that of *H. truei*, and also to that of *P. centralis* Thomas, especially in the heavy ascending branch of the zygomata, which in *H. truei* is much narrower in lateral view. The nasals, however, are markedly different from the nasals in either *P. centralis* or *H. truei*, they terminating considerably anterior to the premaxillaries.

---

[1] Proc. Zool. Soc. London, 1860, p. 265, fig. 1–4, skull.

[2] Thomas, Ann. and Mag. Nat. Hist. (6), XX, Dec. 1897, p. 551.

In 1897,[1] I referred a young specimen of spiney rat collected by Mr. A. Alfaro at Suerre, Costa Rica, to *Echimys* [= *Proechimys*] *centralis*, and later (on the museum label) to *E. semispinosus* Tomes. It proves, however, to be referable to *H. truei*, both in external characters and in the tooth pattern. This shows that the range of *H. truei* extends southward into Costa Rica. It has not been reported from Panama, whence many specimens of spiney rats have been received in recent years, all referable to the *Proechimys centralis* group, except the San Miguel Island form described by Bangs as *Loncheres* [= *Echimys*] *labilis*. This makes the third genus of spiney rats now known from Central America.

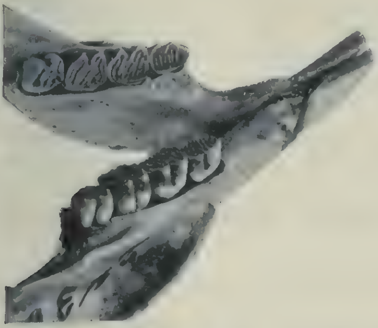


Fig. 3.

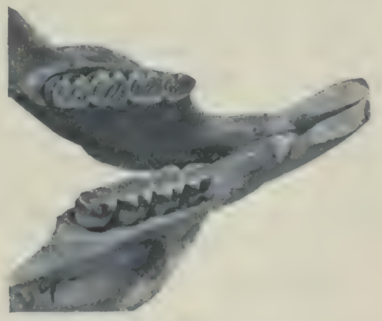


Fig. 4.

Fig. 3. *Hoplomys truei*. Lower jaw of skull shown in Fig. 1. $\frac{2}{1}$.
Fig. 4. *Proechimys trinitatis*. Lower jaw of skull shown in Fig 2. $\frac{2}{1}$.

The heavy-spined *Echimys gymnurus* Thomas, from northern Ecuador, differs radically in coloration from *H. truei* but agrees with it in tooth pattern, in the coarseness of the dorsal spines and (comparatively) hairless tail. It is beyond question a species of *Hoplomys*.[2]

---

[1] Bull. Amer. Mus. Nat. Hist., IX, p. 42.

[2] On referring to my notes on the Echimyinæ made at the British Museum in 1901, I find *Echimys gymnurus* Thomas indicated as the type of a "gen. nov.," with a rough sketch of the tooth pattern. The genus is here first published (see above) as *Hoplomys*, with *H. truei* as type, a species congeneric with *H. gymnurus*.

This species is named in honor of Dr. F. W. True, Curator of the Department of Biology, U. S. National Museum, who was the first to make known the occurrence of any member of the Octodontidæ in Central America.[1]

19. **Heteromys vulcani** sp. nov.

Type, No. 28315, ♀ ad., Volcan de Chinandega, altitude about 4000 feet, May 4, 1907; W. B. Richardson.

Soles hairy, 5-tuberculate; no lateral line. Above blackish, varied with gray, owing to the whitish basal portion of the spines showing at the surface, especially on the sides, black prevailing over the median area; ventral surface and inside of limbs white or yellowish white; *fore limbs wholly white*; hind limbs externally like the dorsal surface; fore and hind feet white; ears small, rounded, scantily haired, dark brown or blackish, very faintly edged with white; tail bicolor, blackish above, whitish below, very scantily haired, the annulations unconcealed, and slightly tufted. In the adults the spines are heavy, nearly without intervening hairs; in younger specimens the spines are weaker and mixed with dark hairs, annulated with pale rufous, giving a slight ruddy tinge to the dorsal surface.

Total length (type), 220 mm.; tail, 110; hind foot, 25 (collector's measurements). Four adult specimens, total length, 205 (190–220); tail, 100 (90–110). Skull (type), total length, 31; condylo-basal length, 27; zygomatic breadth,—; interorbital breadth, 7; mastoid breadth, 14; length of nasals, 11; breadth of rostrum at middle, 5; upper molar series, 4. Four other adult skulls give the same total length, and practically the same mastoid breadth.

This species is represented by 12 specimens, mostly adult, but several are in poor condition. Nearly all are from the type locality.

Heteromys vulcani is easily recognized by the combined characters of small size, hairy soles, fore limbs wholly white, and absence of a lateral line. The type is the only specimen in the series in which the tail exceeds 100 mm. The nasals are emarginate or V-shaped posteriorly, and terminate slightly in advance of the posterior border of the premaxillæ.

20. **Heteromys fuscatus** sp. nov.

Type, No. 28451, ♂ ad., Tuma, Nicaragua, Dec. 1, 1907; W. B. Richardson.

General color above blackish, darker on the head, slightly varied with buffy gray; back slightly suffused with fulvous; sides pale fulvous strongly lined with black; top and sides of nose nearly black; thighs and outer surface of hind limbs and buttocks dusky gray or blackish; outer surface of fore limbs gray; upper surface of fore and hind feet whitish; ventral surface and inside of limbs pure white; no fulvous lateral line; tail nearly naked, bicolor, blackish above, whitish below; ears nearly naked, dusky, with a barely perceptible edging of white; soles of hind feet naked, brownish black, 6-tuberculate.

---

[1] 'On the Occurrence of *Echinomys semispinosus* Tomes, in Nicaragua.' Proc. U. S. Nat. Mus., XI, 1888, pp. 467, 468.

This record is based primarily on three specimens collected in the vicinity of Greytown, which proved to be not *E. semispinosus* Tomes, but referable to a new species later described by Thomas, from Nicaragua specimens, as *E. centralis*. In the same connection he also made mention of three specimens from Pacuare, Costa Rica, likewise referred by True to *E. semispinosus*. Through the kindness of Dr. M. W. Lyon, curator of mammals at the U. S. National Museum, these six specimens have been sent to me for examination, and all prove to be referable to *Proechimys centralis*.

Total length (type), 300 mm.; tail, 150; hind foot, 30 (collector's measurements). Three specimens (2 ♂, 1 ♀) measure, total length 293 (280–300); tail, 153 (150–160). Skull, occipitonasal length, 36.3; condylo-basal length, 32; zygomatic breadth, 15.7; interorbital breadth, 10; mastoid breadth, 15.5; length of nasals, 10; width of rostrum above base of incisors, 5; upper molar series, 4.5.

This species agrees in size and proportions with *H. repens* Bangs, from Panama, except in having smaller feet, but differs from it greatly in coloration, being much darker, while the suffusion of the upper parts is much paler — buff instead of tawny. The skull differs in the less posterior extension of the nasals, which terminate slightly in front of the posterior border of the premaxillæ instead of extending decidedly beyond them.

This species is based on 4 specimens, the type, from Tuma, a second specimen from Chontales, and two from Matagalpa. All are adult, but the Chontales specimen is a little younger than the others, and a little smaller and darker.

21. **Neotoma chrysomelas** sp. nov.

Type, No. 28372, ♀ ad., Matagalpa, Nicaragua, Sept. 17, 1907; W. B. Richardson.

Sides of body, from nose to thighs, golden brown; dorsal region, from top of head to base of tail, similar but heavily overlaid by black-tipped hairs, rendering the dorsal area blackish; ventral surface white, with the basal half of the pelage dusky, usually showing more or less at the surface along the lateral borders and inside of hind limbs; fore and hind limbs passing into dusky apically; fore feet abruptly silvery white; hind feet whitish, mottled with dusky, sometimes the white, sometimes the dusky prevailing; ears large, dark brown, the apical two-thirds nearly naked; tail heavily haired, wholly concealing the annulations, blackish above, grayish white below.

Total length (collector's measurements), 380 mm.; tail vertebræ, 170; hind foot (from dry skin), 36. Skull, total length, 47; condylo-basal length, 45; zygomatic breadth, 25; length of nasals, 19. Four specimens (3 ♂, 1 ♀), all adult, measure as follows: Total length, 375 (340–390); tail vertebræ, 160 (150–170). Skull, total length, 45.9 (45–47); zygomatic breadth, 24.7 (24–25); nasals, 18.2 (17.8–19). All the specimens were taken at the type locality.

Neotoma chrysomelas is a member of the *N. ferruginea* group, to which also belong *N. picta* and *N. isthmica*, and perhaps other ferruginous forms of southern Mexico. It differs from *N. ferruginea* Tomes, its nearest geographical ally (type locality, Dueñas, Guatemala), in larger size, relatively broader skull, and longer nasals (skull of *N. ferruginea*, total length, 45 zygomatic breadth, 21, nasals, 16.7). The two forms apparently are quite similar in coloration, judging from Tomes's description (P. Z. S., 1861, pp. 282–284).

22. **Akodon teguina** (*Alston*). Five specimens, all collected at San Rafael del Norte, altitude 4000 to 5000 feet, April 12–17, 1907. Provisionally referred to *A. teguina*, the type locality of which is Coban, Guatemala, although probably subspecifically different.

23. **Reithrodontomys modestus** *Thomas*. Seven specimens, of which four are from San Rafael del Norte and three from Lavala. Unfortunately the skulls are lost or too much broken to be of use in identification. Three adults measure, total length, 140 mm., tail, 70–75. A young adult agrees very well with Thomas's description of *modestus*, but two adults differ in having the sides of the body strongly suffused with yellowish rufous, and the tail is gray below instead of concolor, and the breast spot is fulvous instead of drab, as in the younger specimens. The type locality of *modestus* (Jinotega, Nicaragua, altitude 4650 feet) is only a short distance from San Rafael del Norte.

24. **Reithrodontomys** sp. One specimen, without skull, Ocotal, May 11, 1908. A dull-colored medium-sized species; total length, 170 mm., tail, 80.

25. **Reithrodontomys** sp. Two immature specimens, without skulls, one each from Rio Grande and Tuma (below 1000 feet).

26. **Reithrodontomys** sp. One specimen, San Rafael del Norte, April 10, 1907. A very small species with a very long tail (total length, 140 mm., tail, 90), wholly unlike the other San Rafael specimens of *Reithrodontomys*.

Further notice of these undetermined species of *Reithrodontomys* is deferred in the hope that additional specimens with good skulls will be received in later shipments.

27. **Oryzomys** (**Melanomys**) **chrysomelas** *Allen*. Sixteen specimens all from the east coast low country, as follows: Lavala, 2 specimens, Oct. 11 and 13, 1907; Tuma, 6 specimens, Nov. 20–28, 1907; Chontales, 2 specimens, Feb. 20 and 25, 1908; Rio Grande, 6 specimens, Feb. 25, 28, March 30, April 2 and 4, 1908.

The collector's measurements of 12 specimens, about an equal number of males and females, all adult, are: Total length, 206 mm. (200–220); tail vertebræ, 98.5 (80–110); hind foot, without claws, 20.1 (20–20.5).

Externally these specimens are indistinguishable from the original type series of five from Suerre, Costa Rica, of which there were no external measurements, of which none was very old, the teeth of all being nearly unworn. In the present series the skulls average slightly larger, evidently owing to the greater age of most of the specimens, in some of which the teeth are much worn.

28. **Oryzomys couesi** *Thomas* (ex Alston). Twenty-nine specimens, of which 23 are from Chontales, Feb. 8–28, 1908; 2 from Ocotal, May 4 and 11, 1908; 1 from San Rafael del Norte, April 12, 1907, and 3 from Tuma, Nov. 3, 23, and 24, 1907.

These specimens agree satisfactorily with Thomas's redefinition[1] of *O. couesi* (type locality, Coban, Guatemala). The coloration above is fulvous, finely lined with black on the back, which is thus somewhat darker than the sides; below buffy white. Very old specimens are brighter colored, tending to rufous on the lower back and to strong buff below. Ten of the oldest specimens of the series (judging by the skulls) measure (collector's measurements), total length, 268 (260–280); tail, 136 (130–140). Basal length of skull, 27.5–29.5; nasals, 11–11.6; width of braincase, 12.2–12.7.

This species has apparently a wide range, from the low Atlantic coast district (altitude 500 to 1000 feet) to the highlands (altitude 4000 to 5000 feet) of the central part of the Republic, specimens from the latter district being in no way distinguishable from those from the former.

29. **Oryzomys alfaroi** *Allen.* Nine specimens: Chontales, 6 specimens, Feb. 13–25, 1908; Tuma, 3 specimens, Nov. 15–18 and 25, 1907.

These specimens are indistinguishable from the type and topotypes of the species, from San Carlos, Costa Rica.

30. **Oryzomys alfaroi incertus** subsp. nov.

Type, No. 28584, ♂ ad., Rio Grande, March 28, 1908; W. B. Richardson.

Differs from *O. alfaroi alfaroi* in smaller size, darker back, and golden rufous instead of pale fulvous suffusion of the upper parts. Total length (type), 190 mm.; tail, 100. Two other specimens measure, respectively, total length 190 and 200; tail, 100. Five specimens of *alfaroi* from Chontales measure, total length, 210 (200–220); tail, 106 (100–110). The skulls are badly broken, lacking the occipital portion, but so far as they can be compared appear to present no distinctive features.

31. **Oryzomys ochraceus** sp. nov.

Type, No. 28548, ♂ ad., Rio Grande, Nicaragua, March 27, 1908; W. B. Richardson.

Pelage very thick, long and soft. Upper parts ochraceous, somewhat darker on the back by the admixture of black-tipped hairs, and brighter on the flanks; top and front of head not darker than the body; under parts strongly washed with buff or pale yellow; ears dark brown, naked; upper surface of fore and hind feet dingy grayish brown; tail uniform dark brown throughout, not lighter below, naked in some specimens, in others with very short fine hairs, not concealing the annulations.

Total length (type), 300 mm.; tail, 180; hind foot, 40 (collector's measurements).

---

[1] Ann. and Mag. Nat. Hist. (6), Vol. XI, May, 1893, pp. 403, 405.

The type is a very old male. Three other specimens, the smallest a young adult, measure respectively as follows: total length, 280, 310, 340; tail, 150, 170, 180.

The skull, particularly in the old specimens, is very broad and heavy, with the supraorbital ridge very heavy and broadly overhanging the orbits. Total length (type), 36; condylo-basal length, 30; zygomatic breadth, 20; interorbital breadth, 7; mastoid breadth, 13; length of nasals, 14; upper toothrow, 6. Posterior border of nasals ending in a V-shaped point, opposite the front border of the orbit. Anterior palatal foramina short and broad, 5 × 2 mm. The skull in 4 specimens (one a young adult) averages, total length, 35.5; zygomatic breadth, 19.

O. ochraceus differs greatly from any other species of *Oryzomys* known to me. A marked feature is its heavy soft pelage, which has a length on the back of about 15 mm., the basal four-fifths of which is deep plumbeous, the hairs individually tipped with rufous, mixed with others tipped with black. On the ventral surface the basal part of the pelage is grayish plumbeous, the surface heavily washed with deep buff or pale yellow. In external measurements it is much smaller than *O. devius* Bangs, from Chiriqui, and differs from it markedly in coloration, in the character of the pelage, and in the form of the skull (compared with topotypes of *O. devius*). From *O. talamancæ* Allen (compared with the type) it differs in much larger size and in coloration. It also appears quite distinct from any species thus far known from Guatemala or Mexico.

[I take the present opportunity to describe a strongly marked new species of *Oryzomys* from Costa Rica, collected by M. A. Carriker, Jr., in 1904, as follows:

Oryzomys carrikeri sp. nov.

Type, No. 25976, ♀ ad., Rio Sicsola, Talamanca, Costa Rica, August 18, 1904; M. A. Carriker, Jr., for whom the species is named.

Pelage very short, fine, soft and velvety. Sides, from nose to rump, ochraceous brown; back dark brown suffused with ochraceous; below, from chest to base of tail, uniform gray — dark gray in worn pelage, gray washed with whitish in fresh pelage; chest and throat whitish — nearly white in fresh pelage; ears of medium size, dark brown, almost naked; fore feet whitish, hind feet flesh color, nearly naked; tail practically naked (all the scales distinctly visible), dull brown above, lighter below, especially on the basal fourth.

Total length (type), 265 mm.; tail, 133; hind foot, 30.5 (collector's measurements). Two other specimens measure respectively: ♂ ad., 248, 121, 29.5; ♀ juv. ad. (a nursing female), 240, 118, 30. Skull (type), total length, 31.5; condylobasal, 26; zygomatic breadth, 14.7; interorbital, 5; mastoid, 11.2; nasals, 12; upper molariform series, 5. The adult male skull gives essentially the same measurements; the young adult female skull is about 2 mm. shorter, with the other dimensions in proportion. The nasals extend posteriorly considerably beyond the premaxillaries and end in an obtusely V-shaped point. The supraorbital ridges are well-developed; the anterior palatine foramina are narrow anteriorly and diverge posteriorly, the two foramina forming a V-shaped opening.

Represented by three specimens, all from the type locality and all collected August 18, 1904, by Mr. M. A. Carriker, Jr.

Oryzomys carrikeri belongs to the same group as *O. alfaroi* of Costa Rica, *O. gracilis* of Ecuador, *O. velutinus* of northeastern Colombia, and *O. villosus* of Trinidad. It differs from *O. alfaroi* in its much darker coloration above, suffused with ochraceous instead of pale yellow, and in being nearly twice larger. In size and coloration it approaches *O. villosus* and *O. velutinus*, especially the latter, some of the adult topotypes of which are almost indistinguishable in coloration from *O. carrikeri*, but the ears in both the Trinidad and Colombian species are fully twice the size of those of *carrikeri*, while the cranial differences are strongly marked.

O. talamancæ, also from Talamanca, belongs to a quite different group,[1] in a general way resembling *O. costaricensis*, but about twice the size of that species.]

32. **Sigmodon hispidus griseus** subsp. nov.

Type, No. 28497, ♂ ad., Chontales (in the coast lowlands), Nicaragua, Feb. 20, 1908; W. B. Richardson.

General color above dark gray; underparts whitish gray. Middle of dorsal region, from front of eyes to base of tail, gray, heavily lined with black; sides lighter, more yellowish gray and less varied with black; feet gray; tail blackish brown above, somewhat lighter below, very slightly haired.

Three adults (collector's measurements), total length, 280–300 mm.; tail, 110–130; hind foot (skin), 31.

This form differs from *S. h. borucæ*, its nearest known geographical ally, in the gray color of the dorsal surface, which agrees almost exactly with that of average specimens of *S. h. littoralis* from Florida, to which in coloration it bears a striking resemblance. It further differs from *borucæ* in the form of the skull, which is much broader in proportion to the length. Thus, in comparable skulls, the total length in *griseus* is 37 mm., with a zygomatic breadth of 21.5; in *borucæ* these measurements are respectively 38 and 20.5. The pelage of *griseus* is harsher and coarser than in *borucæ*.

Of the 9 adult specimens in the present series 7 are gray like the type above described, while one has a slight suffusion of rufous, but much less than average specimens of *borucæ*. The other adult specimen is in abnormal pelage, which in both color and texture greatly resembles that of a half-grown brown house rat (*Mus norvegicus*). The two young examples (nurslings) are much darker than *borucæ* of corresponding age, and the suffusion is pale fulvous instead of rufous.

---

[1] I am indebted to Dr. M. W. Lyon, Jr., Assistant Curator, Division of Mammals, U. S. National Museum, for an opportunity to reëxamine the type of *O. talamancæ* in the present connection.

33. **Ototylomys fumeus** sp. nov.

Type, No. 28291, ♂ ad., Matagalpa, Nicaragua, March 18, 1907; W. B. Richardson.

Above dusky gray brown, darkening on the middle of the back to blackish brown; below pure white, the pelage short, thick and soft; outside of limbs like the dorsal surface, as far as the base of the toes, which are whitish with a dusky spot at the base; inside of limbs pure white to the base of the toes; ears dusky brown, apical three-fourths naked, not larger than is usual in *Neotoma*; tail naked, the scales large and smooth, black, slightly lighter on ventral surface.

Total length (type), 330 mm.; tail vertebræ, 140; hind foot, 30 (collector's measurements). Four adult specimens (1 ♂, 3 ♀) measure: Total length, 320 (300–330); tail, 148 (140–170 — only one 170). Skull (type, ♂), total length, 42; condylo-basal length, 38; zygomatic breadth, 21; length of nasals, 14. An adult female, total length, 42; condylo-basal, —; zygomatic breadth, 21.5; nasals, 15. (The five other skulls are too much broken or are too immature for measurement).

Represented by 7 specimens, of which 4 are fully adult with worn teeth, the others immature. The half-grown young are dark grayish brown above, heavily washed with black; below white. Five were taken at Matagalpa, one at Ocotal and one at Volcan de Chinandega. It thus appears to range from about 4000 to about 6000 feet.

This species is much larger than the other known forms of the genus (from Yucatan and Campeche), with a relatively shorter tail, smaller ears, and absence of fulvous suffusion, the skull being 4 mm. longer, and the head and body about 30 mm. longer than in *Ototylomys phyllotis* Merriam (type of the genus) from Yucatan, while *O. p. phæus* Merriam, from Campeche, s still smaller.

In the unworn teeth, both upper and lower, the tubercles of the crown are placed directly opposite, three pairs on m 1, two pairs on m 2, and two pairs on m 3, which has a posterior loop in both upper and lower series. When worn down the pattern is much as in *Zygodontomys*.

A striking feature of the tail is the great width of the smooth, black annulations, wholly unconcealed by hairs.

34. **Rhipidomys salvinii** (*Tomes*). Two specimens, referred provisionally to this species, both taken at Ocotal, in the highlands of northern Nicaragua, Feb. 18 and May 9, 1908; both adult males. They seem to agree in every particular with Tomes's description, based on specimens from Dueñas, Guatemala.

35. **Peromyscus nicaraguæ** sp. nov.

Type, No. 28282, ♂ ad., Matagalpa (altitude about 4000 feet), Nicaragua, March 10, 1907; W. B. Rchardson.

Similar in coloration to *P. nudipes* (Allen) from Central Costa Rica, but wholly lacking the brown pectoral spot so conspicuous in *nudipes*; sides paler and much less golden; ventral surface clear white; it is also much smaller with the skull relatively narrower.

Total length (type), 240 mm.; tail vertebræ, 110. Average of 10 adults from Matagalpa, total length, 235 (220–250); tail, 113 (110–130). Skull (type), occipitonasal length, 33.5; width of braincase, 13. Six Matagalpa specimens, occipitonasal length, 32.3 (31–33.5); width of braincase, 13.3 (13–13.5). Ten adult specimens from San Rafael del Norte and Ocotal present the same averages and ranges of variation. (The type is one of the oldest and the largest specimen of the series).

Compared with a similar number of adults of *P. nudipes*, the average differences are as follows: Total length, *P. nudipes*, 260 (255–265); tail vertebræ, 126 (120–135); skull, occipitonasal length, 34 (33–35); width of braincase, 14 (13.7–14.3). Thus *P. nicaraguæ* is about an inch shorter, with the tail half an inch shorter, the skull about 2 mm. shorter and nearly a millimeter narrower across the braincase. The ptergoid fossa in *nudipes* is conspicuously narrower and relatively longer.

This species is represented by about 40 specimens, of which 20 are from Matagalpa, 7 from San Rafael del Norte, and several from Ocotal, Volcan de Chinandega, and 13 from Chontales, the latter unfortunately nearly all young.

36. **Mus rattus** *Linnæus.* Three specimens, all immature. Two are from Matagalpa, Sept. 22, 1907, and one from Lavala, Oct. 12, 1907.

37. **Sciurus boothiæ belti** *Nelson.* Six specimens: Matagalpa, 3 specimens, Jan. 31, Feb. 1, March 7, 1907; Lavala, 1 specimen, Oct. 18, 1907; Chontales, 2 specimens, Feb. 15, 1908.

In five of the specimens the ventral surface is deep rusty rufous, with small irregular patches of white, either on the breast or abdomen or on both, with a median line of white in one. The other (a female) has the ventral surface much paler — yellowish rufous — with a small patch of white on the breast, lower abdomen, and in each axilla.

38. **Sciurus griseoflavus** (*Gray*). Six specimens are provisionally referred to this species. They fall into two groups, both geographically and in coloration: Matagalpa, 3 specimens, Sept. 12, 17, and 28, 1907; Volcan de Chinandega, 2 specimens, May 12, 1907; San Rafael del Norte, 1 specimen, April 7, 1907.

In the Matagalpa specimens, the dorsal surface is pale buffy gray in two, varied with black; in the other the black wash is the prevailing color, and the buffy suffusion is much stronger. The ventral surface in two is mainly white, with a lateral band of yellow extending along the lower edge of the flanks from the head to the base of the tail, and including also the inner surface of both fore and hind limbs; in the other the ventral surface (including inside of limbs) is deep ochraceous yellow, with broad areas of white on the chest and lower abdomen, connected by a narrow median line of white. The fluffy patch at the base of the ears varies from nearly white to clay color.

The two specimens from Volcan de Chinandega have the dorsal surface nearly as in the darkest Matagalpa specimen, black strongly prevailing; the ventral surface in one is pale buffy gray, with patches of white on the breast, axillæ and lower abdomen; in the other the ventral surface is pure white on the neck, breast, proximal half of inner surface of the fore limbs, and on the abdomen, irregularly mottled with patches of pure white and buffy gray, with the hind limbs and feet black.

The single (rather young) example from San Rafael del Norte is like the Volcan de Chinandega specimens, except that the whole ventral surface and inside of the limbs is pure white.

The tail in all is black washed with white, with a slight tendency to a grizzled buffy gray median band on the ventral surface.

It is quite probable that the Volcan de Chinandega specimens represent a geographical form different from that found at Matagalpa, and different from the true *S. griseoflavus.*

39. **Sciurus richmondi** *Nelson.* Three specimens: Chontales, 2 males, Feb. 26, 1908; Rio Grande, 1 male, March 23, 1908. These specimens were taken not far from the type locality of the species.

40. **Sciurus deppei matagalpæ** subsp. nov.

Type, No. 28440, ♀ ad., San Rafael del Norte, Nicaragua, April 10, 1907; W. B. Richardson.

Differs from *S. deppei deppei* in the color of the upper parts, which are yellowish brown instead of rusty brown; underparts yellow, varying in different specimens from pale buff to ochraceous, but generally ochraceous yellow instead of white or grayish white. In size and cranial characters similar to *deppei.*

Represented by six specimens, of which four are from Matagalpa, Feb. 1, and Sept. 1, 1907, and two from San Rafael del Norte, April 10, 1908. They are all uniformly yellowish brown instead of rufous brown above, and strongly ochraceous below. The fore limbs are grayish varying to deep iron gray in some; the tail is washed lightly with white.

41. **Lutra latidens** sp. nov.

Type, No. 28435, ♂ ad., Lavala, Matagalpa, Nicaragua, Oct. 28, 1907.

Distinguished from its near allies by large size, and especially by the massive dentition.

Pelage short and thin; color above dull rather dark uniform brown; below, from chin to behind fore legs, pale fulvous; rest of lower parts pale brown, without distinct rufous suffusion. Nose pad rounded above, as in the Central and South American forms of *Lutra*, not rising into a broad V-shaped point as in the *L. canadensis* group. External measurements, as taken by the collector from the fresh specimen, total length, 1280 mm., tail vertebræ, 490.

The skull is unfortunately broken into small pieces and is thus unavailable for a complete series of measurements. Length of upper molar-premolar series, 37; lower molar-premolar series, 37.5; p^4, on outer side, 13; width at middle, 10.5; oblique length (diagonally from the antero-internal point of lobe to postero-outer angle), 15; p_3, length, 16; width at middle, 8; width near posterior border, 7.6; length of lower jaw, 72; breadth of condyle, 19.2; height at coronoid, 33.4; angle to top of condyle, 12. Bullæ broad and flat.

This form differs from *L. annectens* Forsyth-Major, in its much larger size and in the relatively much greater size of the teeth, the upper premolar-molar toothrow having a length of 37 mm., while the same measurement in a nold male *annectens* is 31; the oblique length of p^4 is 15 and in *annectens* 13, with corresponding differences throughout the dental series. There is also a marked difference in the form of the individual teeth, especially in respect to p^4 and m^1, which in *latidens* much more resemble the corresponding teeth of large northern examples of the *L. canadensis* group, but they are much more massive.

42. **Putorius tropicalis** *Merriam.* Three specimens, all taken at Matagalpa (Jan. 23, 1906, May 4, 1906, and Feb. 7, 1908), and all sexed as male by the collector. Provisionally referred as above.

These specimens, all from the same locality and all of the same sex, present a wide range of variation in color, especially of the ventral surface. In one (No. 28333), the lower surface is nearly white from the thoracic region to the chin, passing posteriorly into pale ochraceous. The brown of the upper parts wholly covers the fore limbs from the toes to the elbows. The white frontal spot is reduced to a narrow transverse line, and the white spot between the ear and eye is reduced to a narrow line. The black below and in front of the eye encroaches upon the sides of the throat. No. 28592 has the white facial markings very broad; the anterior part of the ventral surface is strongly yellow, passing posteriorly into ochraceous, and extending down the inner surface of the fore limbs nearly to the toe pads. There is a distinct black spot on each side of the throat, behind the angle of the mouth, separated from the black of the cheeks by a narrow white line. No. 28322 has the white facial markings of normal extent, and the edge of the upper lip broadly white posteriorly; the under parts are deep ochraceous, becoming lighter on the fore neck and whitish on the chin and upper throat. There is a large brown spot on the inside of the left thigh.

Only one of the specimens is adult, and this is not 'old'. Of this the collector's measurements are: total length, 420 mm., tail vertebræ, 150; hind foot, 50.

43. **Tayra**[1] **barbara inserta** subsp. nov.

Type, No. 28492, ♂ ad., Uluce, Department of Matagalpa, Nicaragua, Jan. 5, 1908; W. B. Richardson.

Body, limbs, and tail black, the black extending forward on the ventral surface to the throat; head and neck duller, brownish black; no trace of a white or yellow spot on the fore-neck.

Size small; skull narrow; zygomatic arches much less expanded than in other members of the Tayra group. Skull (type), condylo-basal length, 110 mm., zygomatic breadth, 69. Unfortunately external measurements from the fresh specimens are not available.

Represented by four specimens, all from the Province of Matagalpa, taken as follows: Lavala, Oct. 13, 1907, young male; Uluce, Jan. 3 and 5, 1908, two young adult males and an adult male (type).

Except in smaller size, less expansion of the zygomatic arches and total absence of a light spot on the fore-neck, this form closely resembles *T. barbara biologiæ* (Thomas) from Panama. The old male skull is slightly smaller than a female skull of corresponding age of *biologiæ*, and very much smaller than male skulls of that form. Costa Rica specimens are intermediate in respect to the throat-spot; in a series of 4 from Talamanca it is wholly absent in two, very slight in one, and greatly reduced in the other.

The Matagalpa series of tayras is of interest as presenting a form in which the usual light spot on the fore-neck is wholly absent, in contrast with all the other forms, and especially with the Colombian form (*T. barbara irara* Allen), which has usually in addition to the fore-neck spot another similar mark on the withers. (*Cf.* this Bulletin, XX, 1904, pp. 36–38.)

44. **Spilogale angustifrons elata** *Howell.* One specimen, adult male, Matagalpa, Sept. 28, 1907.

45. **Mephitis macroura vittata** (*Licht.*). One specimen, adult male, Matagalpa, Dec. 30, 1908.

46. **Potos flavus aztecus** *Thomas.* Two specimens, both adult males, Ocotal, May 11, 1908. They closely resemble Mexican examples.

47. **Bassaricyon richardsoni** sp. nov.

Type, No. 28486, ♀ ad., Rio Grande (altitude below 1000 feet), Atlantic slope, Nicaragua, April 9, 1908; W. B. Richardson, for whom the species is named.

General color above pale fulvous, strongly varied with black-tipped hairs, which

---

[1] For the use of *Tayra* in place of *Galera*, see *antea*, pp. 586–589.

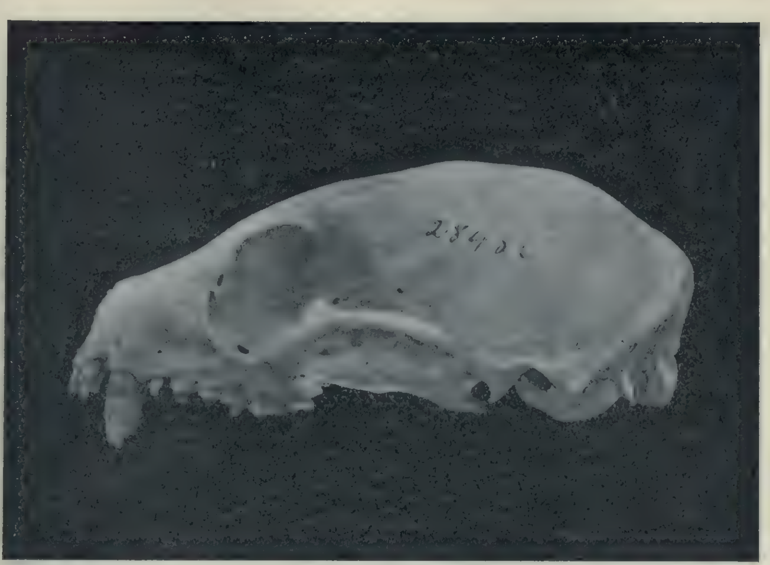


Fig. 5. *Bassaricyon richardsoni.* Type No. 28486, ♀ ad., Rio Grande, Nicaragua. Nat. size.

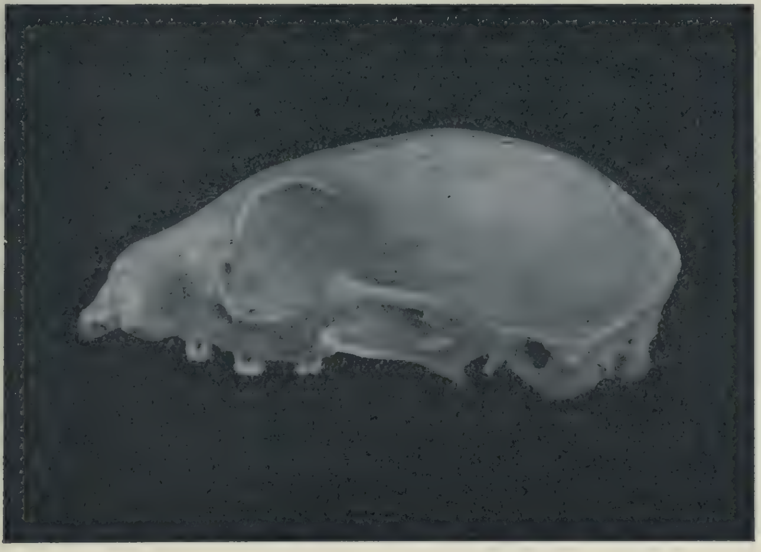


Fig. 6. *Bassaricyon gabbi.* Type, No. 14214 U. S. Nat. Mus. Talamanca, Costa Rica. Nat. size.

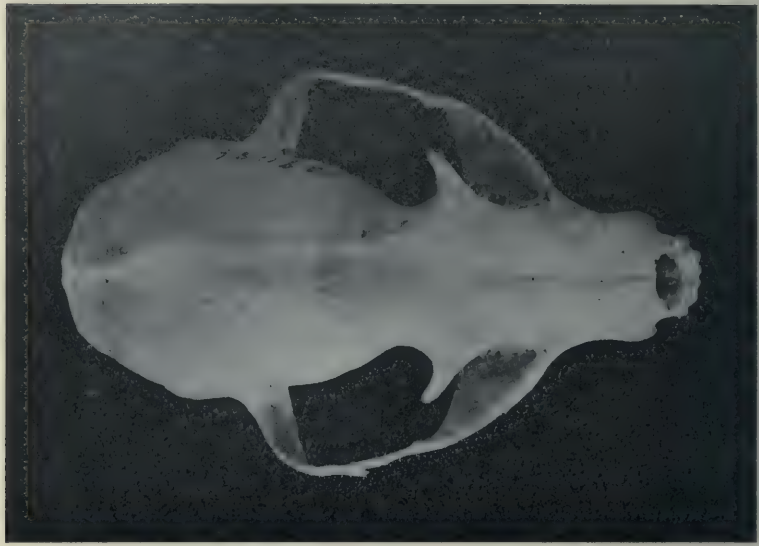


Fig. 7. *Bassaricyon richardsoni.* Same skull as shown in Fig. 5. Nat. size.

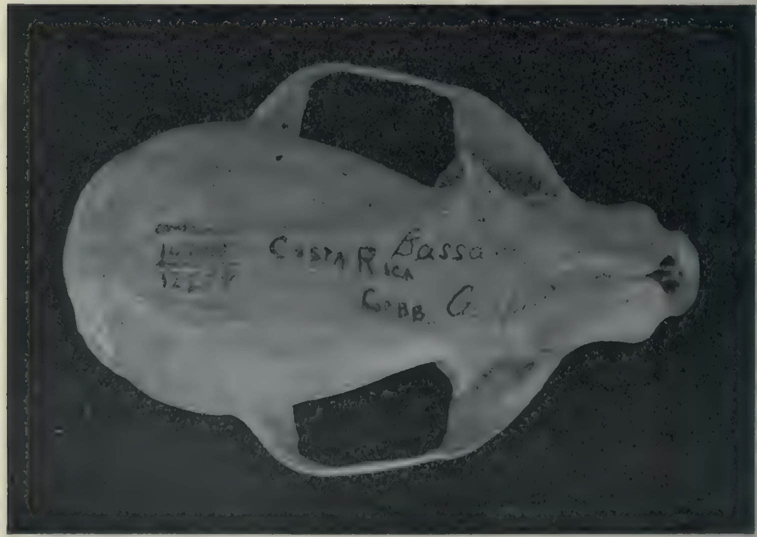

Costa Rica
Bassa
Gabb

Fig. 8. *Bassaricyon gabbi.* Same skull as shown in Fig. 6. Nat. size.

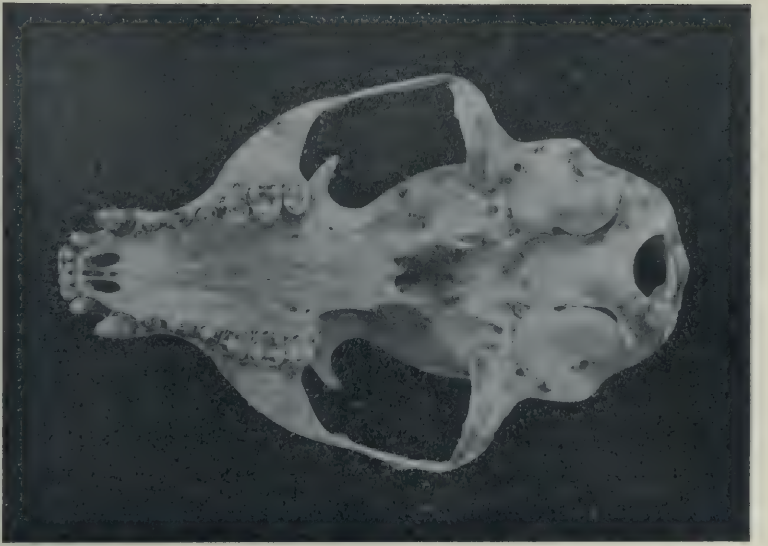


Fig. 9. *Bassaricyon richardsoni.* Same skull as shown in Figs. 5 and 7. Nat. size.

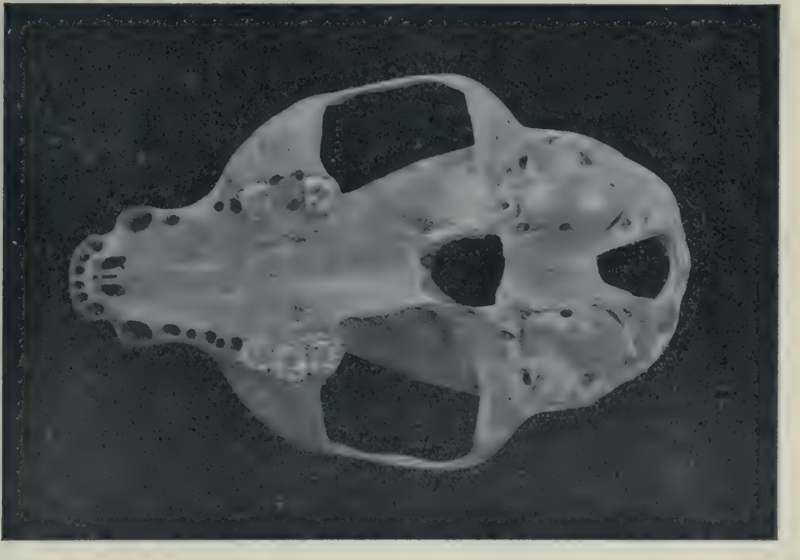


Fig. 10. *Bassaricyon gabbi* Same skull as shown in Figs. 6 and 8. Nat. size.

along the median dorsal area give a prevailing blackish tone to the coloration from the forehead to the base of the tail; sides of body less varied with black, the prevailing color being pale fulvous; ventral surface uniform pale yellow from the fore neck to base of tail; limbs externally like the sides of the body and internally like the ventral surface; a patch below the ear, extending forward nearly to the eye, like the ventral surface; front of head anterior to the eyes, dull grayish brown, minutely varied with black-tipped hairs; sides of nose and chin dusky brown, passing on the throat into fulvous; tail like the body — pale fulvous, strongly varied on the median line above with black-tipped hairs, forming a poorly defined blackish median line, becoming blackish apically with the extreme tip nearly black

Total length, 950 mm.; tail vertebræ, 480; hind foot, 80 (collector's measurements); hind foot with claws, 85. Skull, condylo-basal length, 80.5; basilar length, 73; palatal length, 45; zygomatic breadth, 53; interorbital breadth, 17; width across orbital processes, 32; postorbital breadth, 17.5; breadth at base of canines, 17; mastoid breadth, 34.3; length of upper toothrow, excluding incisors, 28; molar series, 12; lower jaw, length, 58; height at condyle, 11; height at coronoid process, 25.5; lower toothrow, excluding incisors, 30; premolar-molar series, 25.

The type of *B. richardsoni* is, so far as known to me, the sixth known specimen of the genus *Bassaricyon*, which was originally based on a skull, without skin, collected by the late Professor Wm. M. Gabb in Talamanca, Costa Rica.[1] The second known specimen is the type of *Bassaricyon alleni* Thomas, from Sarayacu, Ecuador, collected by Mr. Clarence Buckley.[2] In 1883, M. Huet described and figured two specimens of *Bassaricyon*, received at the Paris Museum of Natural History, from "Caïmito, province de Correo, au nord de Panama," an adult female and a young example (last molar undeveloped).[3] These two specimens were described in great

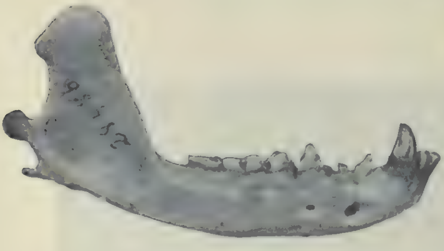


Fig. 11.

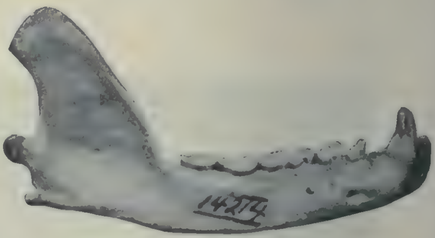


Fig. 12.

Fig. 11. *Bassaricyon richardsoni*. Same skull as shown in Figs. 5, 7, and 9. Nat. size.
Fig. 12. *Bassaricyon gabbi*. Same skull as shown in Figs. 6, 8, and 10. Nat. size.

---

[1] 'Description of a new Generic Type (*Bassaricyon*) of Procyonidæ from Costa Rica. By J. A. Allen. Proc. Acad. Nat. Sci. Phila., 1876, pp. 20–23, pl. i. What was erroneously supposed to be the skin belonging to this skull was subsequently described and figured (Proc. Acad. Nat. Sci. Phila., 1877, pp. 267, 268, pl. ii), the mistake being fully explained later (Bull. Geogr. and Geol. Surv. Terr., Vol. V, No. 2, Sept., 1879, p. 169).

[2] 'On Mammals from Ecuador.' By Oldfield Thomas. Proc. Zool. Soc. London, 1880, pp. 393–403, pl. xxxviii, text figs. 1–4. (*B. alleni*, pp. 397–400, figs. 1–4, pl. xxxviii.)

[3] 'Note sur les Carnassiers du genre Bassaricyon' Par M. Huet, Aide-Naturaliste. Nouv. Arch. du Mus. d'Hist. Nat. de Paris, 2° sér., Vol. V, 1883, pp. 1–12, pll. i–iii.

detail, and a colored plate of the animal and figures of the skulls of both specimens were given, this important memoir forming the entire basis of our present knowledge of the external characters of *Bassaricyon gabbi*.[1]

In March, 1894, a specimen of *B. alleni* (the second known) was received alive at the Menagerie of the London Zoölogical Society, presented by Mr. A. Murray as a kinkajou, and thus at first entered in the records of the Society.[2] It was said to have been "captured in the woods at Bastrica on the Essequibo River, British Guiana," but, as noted below, there seems reason to doubt the correctness of the assigned locality. It lived for several years in the Society's Menagerie, where I had the pleasure of seeing and handling it in 1896. After its death, some years later, Mr. F. E. Beddard published a valuable paper on its anatomy.[3]

M. Huet believed that *B. gabbi* and *B. alleni* were both referable to the same species, the differences between the two pointed out by Thomas being, according to his view, merely individual. In support of this opinion he cited the wide range of variation presented by the kinkajou. His conclusions, however, prove not to have been well founded.

The color of *B. gabbi*, as described and illustrated by Huet, is golden brown above and lighter, more yellow below;[4] it is thus very different from that of either *B. alleni* or *B. richardsoni*, as are also the cranial characters.

Bassaricyon richardsoni, contrary to what might be expected, much more resembles *B. alleni* than it does *B. gabbi*, by which *B. richardsoni* and *B. alleni* are geographically separated, both externally and in the character of the skull. As shown by Thomas's colored plate and description, *B. alleni* has the face clear gray, instead of brown as in *B. richardsoni*, and the general color of "body and tail orange gray, the hairs of the back being tipped with black," instead of pale fulvous gray strongly washed with black. The skull is quite similar in the two species, as regards proportions and general form, both, however, differing widely and similarly from *B. gabbi*. But *B. alleni* and *B. richardsoni* differ markedly in the character of the last upper molar, which in *B. alleni* is much reduced in size and triangular, instead of being circular in outline and much larger.

The teeth of *B. gabbi* and *B. richardsoni* agree essentially in relative size and form, but the skull in the two species is markedly different in contour and in details, as is well shown in the accompanying figures of the type skulls of each (Figs. 5–12). The anterior base of the zygoma is much lower in *B. gabbi* than in *B. richardsoni* and less arched upward; the postpalatal region is shorter and broader, as is also the postpalatal fossa and the pterygoid processes; the bullæ are shorter and more inflated; the rostrum descends much more abruptly and the anterior narial opening is lower and more oblique; the coronoid process is narrower, shorter, and directed less backward.

---

[1] The exact locality of the type specimen of *Bassaricyon* was not given in the original description, but I have recently learned from Dr. M. W. Lyon, Jr., Assistant Curator, Division of Mammals, U. S. National Museum, that it came from Talamanca, on the southeast coast of Costa Rica, and therefore very near the locality of the Paris Museum specimens, which are thus almost topotypes of *B. gabbi*.

[2] *Cf.* Proc. Zool. Soc., London, 1895, p. 521.

[3] 'On the Anatomy of *Bassaricyon alleni*.' By Frank E. Beddard, M. A., F. R. S., Prosector and Vice-Secretary of the Society. Proc. Zool. Soc. London, 1900, pp 661–775, figs. 1–7.

[4] He says: ". . . .le sinciput, la moitié supérieure du cou, les flancs et le dos jusqu'à la base de la queue, les parties externes des membres jusqu'aux extrémités, sont brun roux, Le dessus des extrémités antérieures et postérieures est roux doré. . . . Les parties inférieures en partant du menton, la gorge, le ventre et les parties internes des membres, sont beaucoup plus claires, les poils étant blanc jaunâtre à la base, roux doré clair au milieu et blanc jaunâtre à la pointe. . . ."

As now known, *Bassaricyon* is represented by three well marked species, inhabiting respectively the eastern lowlands of Nicaragua, the lowlands of southeastern Costa Rica and adjoining parts of Panama, and the vicinity of Sarayacu, Ecuador, east of the Andes and well within the upper drainage of the Amazon. If the British Guiana record for *B. alleni* be correct, the group may have a wide range in South America; in which case it seems strange that it has been so long overlooked, and that so few South American examples of it have thus far been obtained. As long since made known by Thomas, Huet, and Beddard, *Bassaricyon* bears a close resemblance externally to the kinkajou, although much smaller and with a non-prehensile tail. It may thus readily be mistaken by collectors and travellers for a young kinkajou.

48. **Nasua narica bullata** *Allen.* Three specimens, males, Lavala, Oct. 12, Tuma, Nov. 29, 1907, and Ocotal, May 7, 1908.

49. **Urocyon cinereoargenteus guatemalæ** *Miller.* One specimen, adult male, Matagalpa, April 20, 1906.

This is one of the smallest specimens of *Urocyon* that has thus far come under my notice, or of which measurements have been published. It is a male, fully adult, as shown by the skull. No external measurements were taken by the collector, and the occipital part of the skull, including most of the braincase, is lacking, rendering the skull measurements incomplete. The palatal length, zygomatic and interorbital breadth, and the breadth across the postorbital processes are practically the same as in the type of *Urocyon parvidens* Miller, from Merida, Yucatan, while the measurements of the teeth correspond exactly with those of *parvidens.* It is much smaller than a female of *U. guatemalæ* Miller (type locality, Nenton, Guatemala), of corresponding age, from Pozo Azul, Costa Rica.

While the present specimen may represent a dwarfed form peculiar to the interior of Nicaragua, it seems better to refer it to its nearest geographical ally rather than to the more distant Yucatan form (*parvidens*), or than to make it the basis of a new name.

50. **Blarina olivaceus** sp. nov.

Type, No. 28356, ♀ ad., San Rafael del Norte (altitude about 5000 feet), Nicaragua; W. B. Richardson.

One of the smallest known species of the genus. Total length, 80 mm.; tail, 17; hind foot, 10. Above grayish brown, with a distinct olivaceous reflection in certain lights; below much lighter, the surface whitish gray, with the same olivaceous reflection as above; feet whitish; ears small, concealed in the pelage; tail with a dusky median line above, sides and below gray.

The skull is imperfect, lacking the parietal and occipital portions. Compared with *B. orophilus* Allen, from Costa Rica, the rostral and interorbital portions of the skull are much narrower and more elongate, the toothrow straight instead of convex outward; the molariform teeth much narrower and the whole dentition weaker. The lower jaw is correspondingly more slender, with narrower and smaller teeth, and the coronoid portion noticeably more slender.

Represented by two specimens, one of them without label or skull, but without doubt from the same locality as the type.

Blarina olivaceus is very unlike any of the species known from Costa Rica and Guatemala; all of the Mexican species are much larger, and otherwise different, except *B. pergracilis* Elliot, from Ocotlan, State of Jalisco, Mexico, which it evidently much resembles in size, slenderness, and coloration, but for geographical reasons it can hardly be specifically the same.

51. **Rhynchiscus naso** (*Wied*). Seven specimens, Tuma, Nov. 22, 1907.

52. **Peropteryx canina** (*Wied*). One specimen, Lavala, Oct. 17, 1907.

53. **Hemiderma perspicillatum aztecum** (*Saussure*). Eleven specimens, Volcan de Chinandega, May 6–12, 1907.

54. **Artibeus jamaicensis richardsoni** sp. nov.

Type, No. 28335, ♂ ad., Matagalpa, Nicaragua, Jan. 3, 1906; W. B. Richardson.

Similar in coloration to *A. intermedius* Allen, but very much smaller. Forearm 53 mm. (in *intermedius* 65); 3d metacarpal, 50 (in *intermedius* 57); tibia 20 (in *intermedius*, 22). A faint whitish stripe from base of nose-leaf to ear.

Skull long and narrow, the brain-case low, not high and vertically expanded as in *intermedius*; palatal region narrower and more depressed, the posterior nares consequently both narrower and shallower; middle incisors relatively larger than in *intermedius*, in comparison with the outer incisors. Total length of skull 29 mm. (as in *intermedius*); zygomatic breadth 17 (19 in *intermedius*); greatest depth of skull, 11 (12 in *intermedius*); mastoid breadth, 15 (16 in *intermedius*). Dentition weaker and teeth narrower. Lower jaw much weaker, less bowed outward, and the coronoid vertical instead of directed outward. Zygoma slenderer and less bowed outward. The dorsal outline of the skull is much as in *Artibeus jamaicensis jamaicensis*; but the skull is narrower, and the dentition heavier, especially the upper incisors.

Represented only by the type, from Matagalpa. A well defined form, recognizable by its small size, and by the narrow, elongated form of the skull and low cranium.

55. **Desmodus rotundus** (*Geoffroy*). Two specimens, Volcan de Chinandega, May 6 and 9, 1907.

56. **Molossus rufus** *Geoffroy*. One specimen, Volcan de Chinandega, May 11, 1907.

57. **Cebus hypoleucus** (*Humboldt*). Four specimens, 2 males and 2 females, all adult, and the skull of another specimen, taken at Lavala, Oct. 6, 1907, Chontales, Feb. 18, and Ocotal, May 11, 1908.

58. **Ateles geoffroyi** *Kuhl*. Four specimens, — three old females and a nearly adult male, Lavala, Oct. 2 and 8, Tuma, Nov. 29, and Uluce, Dec. 31, 1907.

59. **Alouatta palliata matagalpæ** subsp. nov.

Type, No. 28426, ♂ ad., Lavala, Nicaragua, Oct. 13, 1907; William B. Richardson.

In size similar to *A. palliata palliata* and *A. palliata mexicana*, but quite different in color from either, the flank stripes being dark rufous instead of pale rufous or golden (*palliata*), or pale fulvous or grayish fulvous (*mexicana*); suffusion of back dark rufous instead of fulvous or grayish fulvous.

Type, total length, 1120 mm.; tail vertebræ, 620; hind foot, 145. Skull, total length, 107; condylo-basal length, 92; basilar length, 85; zygomatic breadth, 76.

Two specimens, both males, one adult, the other not fully mature, Lavala, Oct. 13, 1907. These specimens differ markedly in color from any in a large series from Panama, and are equally different from any in a considerable series from Vera Cruz, Mexico, and are not intermediate between them, being very unlike either in the rufous suffusion of the lower back and the dark rufous of the flank stripes.

INDEX TO VOLUME XXIV.

New names of genera, species and subspecies are printed in heavy-faced type; also the main references in a series of references.

- Abies, 72.
- Acacia, 72.
  - farnesiana, 96.
  - septentrionalis, 97.
- Acanthis, 28.
- Acanthopneuste, 28.
- Acanthostichus brevicornis, 400.
  - texanus, 400.
- Accipiter, 25.
- Acer, 72, 74.
  - florissanti, 101.
  - indivisum, 84.
- Achrosticum, 74.
- Acorus, 72.
  - affinis, 79.
- Acotherulum saturninum, 271.
- Actitis, 29.
- Actochelidon, 10, 14, 39, 43.
- Actodromas, 14.
- Adiantites gracillimus, 76.
- Æchmophorus, 15.
- Ægialitis, 29.
- Ægithalus flaviceps, 15.
- Aeronautes, 15.
- Æstrelata, 29.
- Æthia, 15, 45.
- Agaphelus gibbosa, 297.
- Agelaius, 29.
- Agriochœridæ, 559, 560.
- Agrion **telluris**, 60.
- Agrioninæ, 60.
- Aimophila, 29.
  - rufescens, 29.
- Aix, 29.
- Ajaia, 15.
- Akodon teguina, 654.
- Alauda, 29.
  - alpestris, 22.
  - arvensis, 29.
  - chsysolæma, 22.
  - spinoletta, 32.
  - spragueii, 21.
- Alca, 10, 29, 42, 43.
  - alle, 05.
  - antiquus, 39.
  - arctica, 18.
  - cirrhata, 36.
  - cristatella, 15.
  - grylle, 16.
  - impennis, 10, 23, 29.
  - monocerata, 16.
  - psittacula, 37.
  - pygmæa, 15.
  - torda, 10, 29.
- Alcedo, 27.
  - amazona, 33.
  - ispida, 27.
  - rudis, 32.
  - torquata, 39.
- Alcella, 15, 45.
- Alces, 546, 549, 557.
- Alianthus, 74.
- Alle, 15.
- Allen, J. A., a list of the genera and subgenera of North American birds, with their types, according to article 30, of the International Code of Nomenclature, 1–49; Pennant's 'Indian Zoology,' 112–116; the North Atlantic Right Whale and its near allies, 277–329; the Peary Caribou (*Rangifer pearyi* Allen), 487–493; notes on *Solenodon paradoxus* Brandt, 505–517; mammalogical notes, I–VI, 579–589; mammals from Nicaragua, 647–670.
- Allosaurus, 185.
- Alnus, 72, 74, 84.
  - cordata, 84.
  - kefersteinii, 84.
  - **præcordata**, 84.
- Alouatta palliata **matagalpæ**, 670.
  - palliata mexicana, 670.
  - palliata palliata, 670.

Alticamelus, 559.
Amaurornis phœnicura, 114.
Amblyopone binodosus, 400.
Amelanchier, 72.
  peritula, 95.
  rotundifolia, 95.
  scudderi, 95.
  typica, 95.
Aminippus, 251, 245.
Amizilis, 25.
Ammodramus, 29, 31.
Ammospiza, 31.
Ampelis, 12, 15, 31, 42, 44.
  garrulus, 12.
  pompadora, 31.
Ampelopsis, 103.
  bruneri, 103.
  bruneri carbonensis, 103.
  montanensis, 103.
  xantholithensis, 103.
Amphispiza, 13.
Amphitragulus, 550.
Amygdalus, 73, 74.
  gracilis, 96.
Anabrus **caudelli**, 63.
Anas, 31.
  acuta, 17.
  albeola, 16.
  anser, 26.
  arcuata, 34.
  bernicla, 32.
  boschas, 31.
  canagica, 22.
  circia, 28.
  clangula, 14.
  clypeata, 24.
  crecca, 21.
  cristata, 27.
  cygnus, 37.
  dominica, 21.
  fuligula, 27.
  fusca, 36.
  galericulata, 29.
  histrionicus, 19.
  hyemalis, 19.
  jamaicensis, 19.
  labradoria, 20.
  mollissima, 24.
  nigra, 37.
  nyroca, 27.
Anas penelope, 36.
  perspicillata, 22.
  pœcilorhyncha, 114, 115.
  querquedula, 28.
  rufina, 21.
  rutila, 16.
  spectabilis, 18.
  sponsa, 29.
  stelleri, 23.
  strepera, 16.
  vallisneria, 15.
Anchitherium gracilis, 229, 258.
Ancodon gorringei, 272.
  minus, 272.
Andrews, R. C., notes upon the external and internal anatomy of *Balæna glacialis* Bonn., 171–182; description of a new species of *Mesoplodon* from Canterbury Province, New Zealand, 203–215.
Andromeda, 72, 74.
  scudderiana, 105.
  rhomboidalis, 105.
Aneimia, 72.
  aurita, 76.
  gracillima, 76.
Anhinga, 15.
  melanogaster, 114.
Ankylosauridæ, 187.
Ankylosaurus, 188.
  magniventris, 188, 201.
Anochetus mayri, 125.
  emarginatus testaceus, 125.
Anous, 10, 31.
  niger, 10, 31.
Anser, 26.
  anser, 26.
  domesticus, 26.
  hypoboreus, 16.
  melanotis, 114.
  rosii, 18.
Antenor, 22.
Antholithes, 74.
  amœnus, 108.
  obtusilobus, 108.
Antilocapra, 559.
Antilocapridæ, 561.
Antilophia, 340.
  galeata, 340.
Antrostomus, 32.

Aphelocoma, 32.
Aphiochæta, 273.
Aphriza townsendi, 15.
Apidium, 271.
  phiomensis, 271, 272.
Apocynophyllum, 72, 74.
  scudderi, 107.
Apterodon macrognathus, 272.
Aquila, 26.
  aquila, 26.
Arachnocephalus, 65.
Aralia, 72, 74.
  dissecta, 104.
  elegans, 104.
  multifida, 104.
Aramus, 15.
Aratinga, 34.
  cyanogularis, 34.
Archibuteo, 15.
Archilestes, 61.
Arctitreta, 57.
  pearyi, 57.
Ardea, 32.
  cærula, 17.
  cinerea, 32.
  egretta, 11.
  grus, 35.
  garzetta, 11, 18.
  javanica, 16.
  ludoviciana, 14.
  rufa, 17.
  scolopacea, 15.
  violacea, 21.
Ardetta, 36.
Ardops, 581.
  haitiensis, 581.
  luciæ, 581.
  nichollsi, 581.
Arenaria, 15.
Aristolochia aurantiaca, 91.
  clematitis, 90.
  cordifolia, 90.
  crassifolia, 90.
  mortua, 90.
Aristonetta, 15.
Ariteus, 581.
Arotopus binodosus, 400.
Arquatella, 15.
Arremonops, 15.
Arsinoitherium, 272.
Artibeus intermedius, 669.
  jamaicensis jamaicensis, 670.
  jamaicensis parvipes, 581.
  jamaicensis **richardsoni**, 669.
  quadrivittatus, 579.
Arundo, 74.
Asarcia, 15.
Asio, 26.
  asio, 26.
Astarte borealis, 57, 58.
  lens, 58.
Aster divaricatus, 108.
  florissantia, 108.
Astragalinus, 32.
Astur, 32.
Asturina, 15.
  cinerea, 15.
Asyndesmus, 15.
Ateles geoffroyi, 670.
Athene, 35.
  whitneyi, 20.
Athyris, 54.
  royssi, 54.
Atilax vansire, 589.
Atocus, 524.
  defessus, 521, 524, 594.
  elefessus, 523.
Atta destructor, 126.
Atthis, 32.
Auriparus, 15.
Aythia, 27, 44.

BÆOLOPHUS, 15.
Balæna, 307.
  antipodarum, 302.
  australis, 288, 290, 292, 302, 306, 307, 308.
  biscayensis, 291–309.
  britannica, 297, 312.
  cisarctica, 293, 295, 297, 298, 299, 300, 301, 304, 305, 311, 324.
  gibbosa, 295.
  glacialis, 171, 182, 288, 289, 304 305, 308, 309, 310.
  glacialis β, 310.
  glacialis, a, australis, 288.
  glacialis, c, borealis, 288, 308.
  glacialis, b, occidentalis, 288.

Balæna islandica, 288, 308, 310.
    japonica, 302.
    lamononi, 299.
    mediterranea, 297.
    mysticetus, 288, 295, 296, 299, 301, 306, 308, 310, 319, 327, 329.
    mysticetus islandica, 310.
    nordcaper, 289, 310.
    novæ-zelandiæ, 302.
    occidentalis, 288.
    sieboldii, 305.
    tarentina, 299, 303, 309, 310.
Balæna (Eubalæna) biscayensis, 292.
    (Hunterius) biscayensis, 294, 311.
Baleine de Biscaye, 292.
Baleine franch du golfe de Biscaye, 292, 310.
Banksites lineatus, 90.
Bartramia, 15.
    laticauda, 15.
Basileuterus, 15.
Basilinna, 32.
Bassaricyon, 648.
    alleni, 666–668.
    gabbi, 667, 668.
    richardsoni, 662, 666, 667, 668.
Bernicla, 26.
Betula, 72.
    florissanti, 84.
    pumila, 85.
    truncata, 84.
Beutneria (?) **perplexans**, 104.
Blarina **olivaceus**, 669.
    orophilus, 669.
    pergracilis, 669.
Blastomeryx, osteology of, 535–562.
    antipolinus, 546.
    borealis, 546.
    gemmifer, 545.
    olcotti, 539, **543**, 544, 548.
    primus, 537, **543**, 544, 548.
    wellsi, 545.
Bombycilla, 15.
    cedrorum, 15.
Bonasa, 32.
Boschas, 31.
Botaurus, 32.
Bovidæ, 559, 561.
Brachiopoda, 51.
Brachymyrmex heeri, 153.
    heeri depilis, 387.
    heeri var. obscurior, 153, 162.
    minutus, 162.
Brachyramphus, 32.
    hypoleucus, 14.
Bradypus griseus, 648.
Branta, 32.
Brasenia, 74.
Brewsteria, 15.
Brontotherium **hatcheri**, 615.
Brown, Barnum, the Ankylosauridæ, a new family of armored Dinosaurs from the Upper Cretaceous, 187–201.
Brues, Charles T., two fossil Phoridæ from the Miocene Shales of Florissant, Colorado, 273–275.
Bubo, 26.
Budytes, 15.
Buettneria, 73.
    catalpifolia, 104.
    perplexans, 104.
Bulweria, 15.
Bumelia, 72.
    angustifolia, 105.
    florissanti, 105.
Burrica, 13.
Buteo, 26.
    brachyurus, 16.
Buteola, 16.
Butorides, 16.

CÆNONEURA, 61.
Calamospiza, 16.
    melanocorys, 16.
Calcarius, 16.
Calidris, 16.
Callichelidon, 13.
Callipepla, 16.
    strenua, 16.
Callothrus, 24.
Calopteryginæ, 60.
Calothorax, 16.
    calliope, 24.
Caluromys laniger pallidus, 648.
Calypte, 32.
Camarophoria, 56.
Camarotechia, 56.

Camelidæ, 561.
Camelomeryx, 557, 559.
Camelus, 559.
Campephilus, 16.
Camponotinæ, 622.
Camponotus capperi, 162.
    capperi corticalis, 163.
    capperi corticalis var. **subdepilis**, 163.
    conspicuus, 163.
    ferrugineus, 625.
    fugax, 163.
    hannani, 163.
    hannani willardi, 163.
    herculeanus, 625.
    inflatus, 389.
    ligniperdus var. noveboracensis, 625.
    inæqualis, 156.
    pennsylvanicus, 625.
    ruficeps, 156.
    sexguttatus, 156.
    ustus, 156.
Camptolasmus, 20, 44.
Camptostoma, 16, 44.
    imberbe, 16.
Canace, 13.
Canachites, 13.
Canis latrans, 584.
    latrans pallidus, 584.
    lestes, 581.
Canutus, 40.
Caprimulgus albicollis, 21.
    carolinensis, 32.
    nuttalli, 22.
    virginianus, 16.
Carbo penicillatus, 17.
Cardellina, 16.
    amicta, 16.
Cardinalis, 26.
    sinuatus, 23.
    virginianus, 26.
Cardiocondyla emeryi, 118, 128, 130, 160.
    nuda, 128.
    parvinoda, 128.
    venustula, 118, **128**, 130.
Carduelis, 26.
Carduus, 72.
    florissantensis, 108.
Carnifex, 12.
Carpinus, 72.
    attenuata, 84.
    fraterna, 84.
    grandis, 84.
Carpites gemmaceus, 108.
    miloides, 108.
    pealei, 108.
Carpodacus, 32.
Carya bruckmanni, 80.
    ventricosa, 81.
Casarca, 16.
Case, E. C., notes on the skull of *Lysorophus tricarinatus* Cope, 531–533.
Cassia fischeri, 96.
Castanea, 72.
    atavia, 87.
    castaneæfolia, 86.
    dentata, 87.
    dolichophylla, 85, 87.
    intermedia, 85, 87.
    kubinyi, 87.
    pulchella, 86.
    pumila, 87.
    ungeri, 86, 87, 88.
Cataglyphis, 346, 347.
    melligera, 356.
Catharacta skua, 20.
Catharista, 11, 32, 43.
Cathartes, 11, 32, 43.
Catherpes, 16.
Catoptrophorus, 16.
Cebus hypoleucus, 670.
Cecidomyia **pontaniiformis**, 66.
Cecropia adenopus, 122.
    peltata, 122.
Celastrinitis, 73.
    elegans, 100.
Celastrus, 72.
    flaxinifolius, 100.
    greithianus, 100.
    lacoei, 100.
Celtis, 72, 74, 88.
    mccoshii, 92.
Centrocercus, 13.
Centurus, 16.
    carolinensis, 16.
Centronyx, 16.
Ceophlœus, 14, 44.

Cepphus, 16.
  lacteolus, 16.
Cerapachys (Parasycia) augustæ, 401.
Cercis, 72.
  parvifolia, 96.
Cerchneis, 16.
Cerorhincha, 16.
  occidentalis, 16.
Certhia, 32.
  familiaris, 32.
Cethiola flaveola, 17.
Cervavus, 559.
Cervidæ, 561.
Cervulus, 559.
Cervus, 557, 558, 559.
  tarandus var. arctica, 583.
  tarandus var. sylvestris, 583.
Ceryle, 32.
Chæmepelia, 33.
Chætura, 32.
  macroptera, 32.
Chamæa, 16.
Chamæthlypis, 14.
Chara, 72.
  compressa, 75.
  glomerata, 72.
  peritula, 75.
  springeræ, 75.
  stantoni, 75.
Charadrius, 33.
  apicarius, 33.
  calidris, 16.
  hiaticula, 29.
  himantopus, 27.
  montanus, 23.
  morinellus, 18.
  vociferus, 22.
  wilsonius, 21.
Charitonetta, 16.
Charitospiza, 30.
Chaulelasmus, 16.
Chelidonaria, 16.
Chen, 16.
Chilonycteris macleayii fuliginosa, 581.
Chilopoda, 563, 564.
Chiroprion, 341.
Chiroxiphia, 331.
  atlantica, 331, 334, 336, 342, 343.
  boliviana, 331, 332, 339, 341, 343.
Chiroxiphia caudata, 331, 332, 335, 341.
  lanceolata, 331, 332, 334, 335, 341.
  linearis, 331, 332, 334, 335, 341.
  napensis, 338–340, 342, 343.
  pareola, 337–342, 331–334, 336, 342, 343.
  pareola boliviana, 339.
  regina, 337–339, 342.
Chloroceryle, 33.
Cholœpus hoffmanni, 648.
Chondestes, 16.
  strigatus, 16.
Chordeiles, 16.
Chrysophlegma miniaceum, 114.
Ciceronia, 16.
Ciconia mycteria, 19.
Cinclus, 17.
Circe, 34.
Circus, 33.
  melanoleucos, 114.
Cissus tricuspidata, 103.
Cistothorus, 33.
Clangula, 26.
Clepsydrops, 185.
Clivicola, 24.
Coccyzus, 17.
Cockerell, T. D. A., fossil insects from Florissant, Colorado, 59–69; the fossil flora of Florissant, Colorado, 71–108.
Cœligena, 17, 27, 44.
Coendu mexicanus, 649.
Cœreba, 17.
Colaptes, 33.
Colinus, 17.
Columba, 33.
  carolinensis, 24.
  cristata, 35.
  cyanocephala, 24.
  livia, 33.
  melanocephala, 114.
  meloda, 36.
  œnas domestica, 33.
  palambus, 33.
  passerina, 33.
  squamosa, 38.
  versicolor, 35.
  zenaida, 28.
Columbigallina, 33.

Columbina, 33.
Colymbus, 33, 42.
    auritus, 18.
    cristatus, 33.
    glacialis, 33.
    imber, 35.
    marmoratus, 32.
    podiceps, 23.
    ruficollis, 24.
    troile, 28.
Compsohalieus, 17.
Compsothlypis, 33.
Comptonia acutiloba, 81.
    insignis, 81, 86.
Contopus, 21, 44.
Conuropsis, 17, 44.
Conurus, 17, 33, 34, 44.
    vittatus, 33.
Conylus, 84.
Coracias galbula, 40.
Corvus, 34.
    canadensis, 37.
    caryocatactes, 21.
    columbianus, 23.
    corax, 34.
    peruanus, 40.
    pica, 28.
    yncas, 40.
Cotile, 24.
Cotinus fraterna, 99.
Coturnicops, 17.
Coturniculus, 31, 34.
Cratægus acerifolia, 95.
    diversifolia, 95.
    flavescens, 95.
    lesquereuxi, 95.
    newberryi, 95.
Creagrus, 17.
Creciscus, 17.
Credneria, 83.
    daturæfolia, 83.
Cremastochilus castaneæ, 625.
Cremastogaster **arizonensis**, 482.
    ashmeadi, 482.
    brevispinosa, 482, 483
    clara, 481.
    difformis, 390–392.
    inflata, 390–392.
    læviuscula, 480, 481.
    lineolata, 480, 481.
Cremastogaster lineolata coarctata, 482.
    lineolata coarctata var. mormonum, 482.
    lineolata læviuscula var. **clara**, 481.
    lineolata læviuscula, 480, 481.
    lineolata opaca var. **depilis**, 478.
    lineolata opaca var. punctulata, 479.
    minutissima, 484.
    mucronata, 390.
    physothorax, 390, 391.
    rochai, 483.
    steinheili, 132.
    tumidula, 391.
    vicina, 161.
    vicina var. **wighti**, 161.
    victima missouriensis, 483.
    victima var. steinheili, 132, 161.
    virgula, 483.
Crex, 17.
Crotophaga, 17.
    ani, 17.
Crymophilus, 27.
Cryptocerus atratus, 144.
    minutus, 144.
Cryptoglaux, 14.
Cuculus, 34.
    americanus, 17.
    auratus, 33.
    canorus, 34.
    pyrrhocephalus, 114.
Culicivora, 38.
Cupipes ungulatus, 563, 564.
Cuvierius, 294.
Cuvirostra, 36.
Cyanecula, 17.
Cyanocitta, 14.
Cyanolæma, 17, 44.
Cyanospiza, 37.
Cyanosylvia, 17.
Cyclopes dorsalis, 648.
Cycloptilum, 64.
Cyclorrhynchus, 37, 44.
Cymochorea, 14.
Cynanthus, 34, 44.
    latirostris, 34.
Cyperacites, 74.
Cyperus, 74.
Cyphomyrmex foxi, 162.
    rimosus minutus, 149, 162.
Cypseloides, 34.

Cypselus spinicaudus, 33.
Cyptisus florissantianus, 97, 98
  modestus, 98.
Cyrtonyx, 34.
Cyrtopelicanus, 17.

Dafila, 14.
  caudacuta, 14.
Dalbergia, 72.
  cuneifolia, 96.
  melanoxylon, 97.
Daption, 14.
Dasyprocta punctata, 649.
Dendragapus, 14.
Dendrocygna, 34.
Dendroica, 17.
Dendronessa, 29.
Dendrornis, 31.
Densirostra, 18.
Desmodus rotundus, 670.
Devadatta, 62.
Dichobunidæ, 561.
Dichrocerus, 559.
Dichromanassa, 17.
Didelphis mesamericana tabascensis, 648.
Didymosphæria **betheli**, 75.
  typhæ, 75.
Dimetrodon, 184, 185.
Dineura, 529.
  cockerelli, 529, 530, 594.
  fuscipennis, 593.
  geeri, 530.
  laminarum, 529, 530, 594.
Diomedea, 34.
  exulans, 34.
Diopsiulus compressus, 563, 566.
  wheeleri, 563, 566, **568**.
Diospyros, 72, 73.
  brachysepala, 106.
  copeana, 106.
  myosotis, 106.
  princetonia, 105.
Diplopada, 563, 566.
Disparoneura, 61.
Dolichonyx, 17.
Dolichorhinus hyognathus, 611.
  intermedius, 611
Dorcatherium pyramiscus, 150.
  pyramiscus var. niger, 150.
Dryobates, 18.
Dryobius **miocenicus**, 68.
  sexfasciatus, 68.
Dryopteris, 72.
  scansa, 76.
Dumetella, 17, 18, 50.
  felivox, 17.
Dysagrion, 60–62.
  fredericii, 61.
Dysagrioninæ, 60.
Dysporus, 34.
Dytes, 18.

Echimys centralis, 650, 651.
  gymnurus, 647, 650, 651.
  labilis, 651.
  semispinosus, 650, 651.
  subspinosus, 650.
Eciton, 121.
  californicum, 411.
  cœcum, 408.
  commutatum, 413.
  crassicorne, 410.
  erratica, 408.
  esenbecki, 409.
  harrissi, 413, 416, 418.
  jurinei, 408.
  latreillei, 408.
  melsheimeri, 416.
  minor, 418.
  minus, 418.
  nitens, 413.
  omnivorum, 408, 409.
  opacithorax, 411, 412, 418.
  pauxillum, 412.
  pilosum, 412.
  schmitti, 410, 411.
  smithii, 408.
  sumichrasti, 410, 411, 418.
  spoliator, 415.
  vastator, 408.
  (Acamatus) **arizonense**, 414–416.
  (Acamatus) californicum, 411.
  (Acamatus) commutatum, 413.
  (Acamatus) harrisi, 413.
  (Acamatus) melsheimeri, 418.
  (Acamatus) mexicanus, 414.
  (Acamatus) minus, 418.
  (Acamatus) nigrescens, 417, 418.

Eciton (Acamatus) opacithorax, 411.
  (Acamatus) **oslari**, 415.
  (Acamatus) pilosum, 412.
  (Acamatus) schmitti, 410, 411.
  (Acamatus) spoliator, 416.
  (Acamatus) sumichrasti, 410.
  (Acamatus) wheeleri, 412.
  (Labidus) subsulcatum, 414.
Ectatoderus, 64.
Ectatoma brunnea, 123.
  quadridens, 123.
  (Halcoponera) strigatum, 159.
Ectopistes, 64.
  migratoria, 34.
Egretta, 11, 18, 43.
Elainia cayenensis, 14.
Elanus, 18.
  cæsius, 18.
Emberiza americana, 39.
  bairdii, 16.
  bilineata, 13.
  nivalis, 23.
  oryzivora, 17.
  rufivirgata, 15
Empidonax, 18.
Endomychura, 14.
Engelhardtia, 73.
Eneopterinæ, 64.
Eniconetta, 23.
Eohippus, 231, 233, 234, 246.
  angustidens, 223, 235, 236, 244, 259.
  borealis, 222, **242**, 244, 259.
  craspedotus, 225, 239, 241, 244, 246, 259.
  cristatus, 226, 239, 241, 242, 259.
  cristonensis, 224, 237, 238, 243, 259, 262.
  etsagicus, 226, 238, 240, 243, 259.
  index, 222, 223, 234, 242, 259.
  montanus, 226, 239, 243, 259.
  pernix, 224, 231, 259.
  resartus, 223, **240**, 259.
  tapirinus, 223, 259.
  validus, 224, 231, 236, 259.
  vasacciensis, 222, 259
  venticolus, 225, 245, 253, 254, 259, 262.
Eomys zitteli, 269, 270.
Eotitanops, 600.
  borealis, 600.
Eotitanops brownianus, 600.
Epallage, 62.
Epihippus, 231, 257.
  gracilis, 229, 230, 232, 258, 260.
  parvus, 258, 259, 260.
  uintensis, 229, 258, 260.
Epitritus emmæ, 149.
Equisetum, 74.
Erebomyrma longi, 423.
  peruviana, 423.
Ereunetes, 18.
  petrificatus, 18.
Ergaticus, 18.
Eriocampa **bruesi**, 592.
  wheeleri, 525.
Erionetta, 18.
Eriophyes (?) **beutenmülleri**, 68.
Erismatura, 18.
Erolia, 18.
  variegata, 18.
Erythrina, 32.
Erythrinus, 32.
Eschatius, 559.
Eubalæna, 294, 295, 301, 302, 307.
  antipodarum, 302.
  australis, 279, 302, 307.
  biscayensis, 302, 311.
  cisarctica, 312.
  glacialis, 310, 323, 329.
  japonica, 302.
Eucalyptus, 74.
Eudromias, 18.
Eutheia, 18, 30.
Eugenes, 18.
Euonymus, 74.
Euphagus, 18.
Euphonia, 34.
Euponera stigma, 124.
Eurynorhynchus, 18.
  griseus, 18.
Euspiza, 39.
Exanthemops, 18.
Eysenhardtia, 97.
  adenostylis, 97.
  amorphoides, 97.
  othocarpa, 97.
  spinosa, 97.

FAGARA, 72.
  delicatula, 98.

- Fagara diversifolia, 98.
  - spireæfolia, 98.
- Fagus, 73.
  - castaneæfolia, 87.
  - longifolia, 71.
- Falco, 34.
  - æruginosus, 33.
  - albicilla, 19.
  - buteo, 26.
  - candicans, 19.
  - columbarius, 40.
  - chrysaetos, 26.
  - cyaneus, 33.
  - femoralis, 24.
  - ferrugineus, 15.
  - forficatus, 18.
  - fusco-cærulescens, 24.
  - haliaetus, 22.
  - islandus, 19.
  - lagopus, 15.
  - melanoleucos, 114.
  - nisus, 25.
  - nitidus, 15.
  - palumbarius, 32.
  - peregrinus, 34, 38.
  - plumbeus, 19.
  - pterocles, 24.
  - rupicola, 16.
  - subbuteo, 34.
  - tharus, 23.
  - tinnunculus, 40.
  - unicinctus, 22.
- Fenusa **primula,** 528.
  - pygmæa, 528.
- Ficus, 73, 74.
  - arenacea, 89.
  - arenacea brevipetiolata, 89.
  - **aranaceæformis,** 89.
  - catalpæfolia, 91.
  - **florissantella,** 88.
  - gaudini, 89.
  - haydenii, 88, 104.
  - jynx, 89.
  - lanceolata, 89.
  - **navicularis,** 89.
  - tiliæfolia, 88.
  - trinervis, 89.
  - uncata, 89.
- Flabellaria, 74.
- Florida, 18.
- Fontinalis, 72.
  - pristina, 76.
- Forelius maccooki, 162.
- Formica albofasciata, 156.
  - antiguensis, 127.
  - aserva, 620, 424, 633.
  - atrata, 144.
  - bimaculata, 156.
  - bispinosa, 149.
  - cœca, 408.
  - dakotensis, 642.
  - exsecta, 633.
  - exsecta suecica, 641.
  - exsectoides, 623.
  - familiaris, 150.
  - gungosa, 149.
  - fusca, 374, 620.
  - fusca var. argentata, 625.
  - fusca var. glacialis, 354, 624.
  - fusca var. perpilosa, 354.
  - fusca var. subsericea, 625.
  - glacialis, 620, 624.
  - gracilescens, 154.
  - hæmatoda, 125.
  - longicornis, 154.
  - maxillosa, 125.
  - melanocephala, 150.
  - melligera, 346–348, 356, 361.
  - nana, 150.
  - nitiventris, 354.
  - omnivora, 408.
  - pharaonis, 127.
  - pratensis, 633.
  - quadridens, 123, 144.
  - rufa, 633.
  - rufa integra, 623.
  - rufa obscuriventris, 623.
  - ruficeps, 156.
  - sanguinea, 374, 620.
  - sanguinea aserva, 623, 631–633.
  - sanguinea subintegra, 624, 627–631.
  - sexguttata, 156.
  - schauffussi, 374.
  - stigma, 124.
  - subintegra, 624, 633.
  - subpolita var. neogagates, 625.
  - trunciola, 633.
  - unispinosa, 126.

Formica vagans, 154.
  villosa, 124.
  vinidula, 154.
Francolinus, 26.
Fratercula, 18.
Fraxinus, 72.
  brownelli, 107.
  libbeyi, 87.
  palæophila, 106.
Fregata, 18.
Fregetta, 14.
Fringilla bachmani, 37.
  bicolor, 16.
  carduelis, 26.
  caudacuta, 29.
  chlorura, 21.
  cinerea, 19.
  erythrophthalma, 23.
  graminea, 23.
  iliaca, 22.
  lapponica, 16.
  lepida, 18.
  mexicana, 13.
  ornata, 40.
  passerina, 34.
  pecoris, 20.
  pennsylvanicus, 40.
  pusilla, 24.
  pyrrhula, 28.
  rubra, 23.
  savanna, 37.
  spinus, 28.
  tristis, 32.
  vespertina, 19.
Fulica, 34.
  atra, 34.
  chloropus, 27.
  martinica, 19.
  noveboracensis, 17.
  spinosa, 15.
Fuligula, 26, 27.
Fulmarus, 11, 23, 34, 35, 42, 44.
Furnarius griseus, 35.

GALERA, 586–589.
  subfusca, 586.
Galeoscoptes, 44.
Gallinago, 27.
Gallinula, 27.
  phœnicurus, 114.
Gallopavo, 36.
Garrulus californicus, 32.
Garzetta, 11.
Gavia, 35.
Gelochelidon, 19.
  balthica, 19.
Gelocidæ, 561.
Gelocus, 559.
Geniohyus, 559, 561.
Geococcyx, 19.
  variegata, 19.
Geonomites, 74.
Geophilus **culebræ**, 564.
Geothlypis, 35.
  poliocephala, 14.
Geotrygon, 35.
  sylvatica, 35.
Getonia floribunda, 104.
Giraffidæ, 559–561.
Glaucidium, 35.
Glaucion, 27.
Glaucionetta, 14.
Glossina oligocena, 65, 66.
Glossinidæ, 65.
Glottis, 27.
  natans, 27.
Glyphomitrium cockerelleæ, 76.
Glyptostrobus, 78.
Gracula quiscula, 28.
Granger, Walter, a revision of the American Eocene Horses, 221–264.
Grus, 35.
Gryllus, 65.
Guara, 19.
Guarouba, 34.
Guiraca, 35.
Gymnorhinus cyanocephalus, 17.
Gypagus, 35, 38, 42–44.

HABIA, 25.
Hæmatopus, 19.
Haliæetus, 19.
  nisus, 19.
Halibalæna britannica, 302.
Haliplana, 21.
Halocyptena, 19.
  microsoma, 19.
Harelda, 19.
  glacialis, 19.
Harpes, 19.

Harpes rediviva, 19.
Harporhynchus, 19.
Harpyia, 25.
Hedera marginata, 104.
Heleodytes, 35.
Helinaia, 35, 43.
  vermivora, 12.
Helminthophaga, 35.
Helminthophila, 30, 35.
Helmitheros, 19.
  migratorius, 19.
Helodromas, 19.
Helotherium procyoninum, 227, 230, 247, 248.
Hemiderma perspicillatum aztecum, 669.
Hemipalama, 43.
Hemitelites, 74.
Hermiprocne fumigata, 34.
Herodias, 11, 35, 43.
Herpetotheres sociabilis, 24.
Hesperiphona, 19.
Heteractites, 19.
Heterocelus, 19.
Heteromeryx, 559.
Heteromys **fuscatus**, 652.
  repens, 653.
  vulcani, 652.
Heyderia **coloradensis**, 78.
  decurrens, 78.
Hicoria, 72.
  alba, 81.
  costata, 81.
  juglandiformis, 80.
  princetonia, 80.
  rostrata, 80.
  ventricosa, 81.
Hierofalco, 19.
Himantopus, 27.
Hirundo, 35.
  bicolor, 14.
  caudacuta, 33.
  cyaneoviridis, 13.
  melanogaster, 37.
  purpurea 23.
  riparia, 24.
  rustica, 35.
  serripennis, 24.
  subis, 23.
  thalassina, 39.
Hirundo urbica, 37.
Histrionicus, 19.
Hoerataria, 26.
Holcaspis perniciosus, 376.
Hoplomys, 649.
  truei, 649, 650.
Horizopus, 21.
Hortulanus, 23.
Houppifere, 26.
Hunterius svedenborgi, 299.
Hyæmoschus, 559.
Hydranassa, 14.
Hydrangea, 72.
  bendirei, 92.
  hortensis, 92.
  radiata, 92.
  subincerta, 92.
Hydrochelidon, 10, 36.
Hydroprogne, 43.
Hylatomus, 22.
Hylobrontes, 32.
Hylocichla, 14.
Hylophilus, 22, 44.
  thoracicus, 22.
Hypertragulidæ, 561.
Hypertragulinæ, 561.
Hypertragulus, 539, 559.
Hypisodontinæ, 561.
Hypisodus, 539, 559.
Hypnum, 72.
  brownii, 76.
  haydenii, 76.
Hypoclinea bispinosa, 150.
  vestita, 150.
Hypoderma, 66.
Hyrachyus, 255.
Hyracotherium, 222, 223, 234, 241.
  agile, 228.
  angustidens, 223.
  craspidotum, 225, 244.
  cristatum, 226, 239.
  cuspidatum, 223.
  index, 222, 223, 224.
  osbornianum, 229, 252.
  procyoninum, 227.
  tapirinum, 223, 239, 242, 243.
  vasacciense, 222, 224, 237, 243.
  venticolum, 225, 232, 233, 245.
  (Orohippus) tapirinum, 240.

Hyracotherium (Pliolophus) cristatum, 226.
(Pliolophus) cristonense, 224, 225.
(Pliolophus) montanum, 226, 239.

Iache, 34.
Icteria, 19.
dumicola, 19.
Icterus, 27.
Ictinia, 19.
Idioneura, 61.
Ilex, 72, 74, 83.
cassine, 100.
grandifolia, 100.
knightiæfolia, 99.
leonis, 99.
microphylla, 100.
pseudostenophylla, 100.
rigida, 99.
stenophylla, 100.
subambigua, 100.
subdenticulata, 100.
Ionornis, 19.
Iridomyrmex despertitus, 152.
iniquus, 152.
melleus, 122, **151**, 153.
melleus var. **fuscescens**, 153.
Iridoprogne, 14.
Ispida, 27.
Isoetes, 72.
brevifolius, 77.
velatum, 77.
Iulus cæsar, 563, 575.
curiosus, 563, 574.
Ixobrychus, 36, 44.
Ixoreus, 19.

Jabiru, 19, 44.
Jacamerops, 26.
Jacana, 27.
Juglans, 72, 74.
affinis, 80.
costata, 80.
crossii, 80.
florissanti, 80.
sepulta, 80.
Juglandites ventricosus, 81.
Junco, 19.
phænotus, 19.
Juncus, 72, 74.
crassulus, 79.
setaceus, 80.

Kamtorhynchus, 20, 44.
Kyphobalæna, 307.

Labidus atriceps, 408.
esenbecki, 409.
jurinei, 408.
latreillei, 408.
melsheimeri, 418.
mexicanus, 414.
minor, 418.
nigrescens, 417.
pilosus, 408.
sayi, 408.
servillei, 408.
subsulcatum, 414.
Labrus zeylanicus, 114.
Lagenorhynchus cruciger, 219.
Lagopus, 27.
Lambdotherium popoagicum, 599.
procyoninum, 227.
Lampornis, 29, 31.
amethystina, 31.
Lampronetta, 15.
Lanius, 36.
excubitor, 36.
garrulus, 12.
sulphuratus, 23.
tyrannus, 28.
Lanivireo, 14.
Larrophanes ophthalmicus, 519.
Larus, 36.
albus, 22.
canus, 36.
eburneus, 22.
furcatus, 17.
glaucus, 36.
rissa, 24.
rosea, 24.
sabinii, 25.
Lasiodesmus, 575.
caraibicus, 563, **576**.
Lasius americanus, 368.
brevicornis, 622.
melanocephalus, 150.
niger, 169.

Lasius niger var. americanus, 623.
  niger var. neoniger, 622.
  (Acanthomyops) clariger var. subglaber, 623.
Laurus princeps, 91.
Leguminosites, 74.
  serrulatus, 97, 98.
Leptodesmus mauritii, 563, 575.
  sallei, 563, 575.
Leptogenys septentrionalis, 406.
  (Labopelta) elongata, 406.
Leptomerycinæ, 561.
Leptomeryx, 552, 554, 558, 559.
  evansi, 544–548.
Leptomyrmex varians var. rufipes, 389.
Leptoreodon, 559.
Leptothorax acervorum canadensis, 621.
  curvispinosus, 621.
  emersoni, 621.
Leptotila, 20.
Leptotragulinæ, 561.
Leptotragulus, 559.
Lepus floridanus aztecus, 649.
  floridanus chiapensis, 649.
  gabbi, 649.
  gabbi **tumacus**, 649.
Lestinæ, 60.
Leucæna, 72.
  coloradensis, 96.
  greggii, 96.
Leuconerpes albolarvatus, 25.
Leucophoyx, 43.
Leucosticte, 20.
Libocedrus, 78.
Limnohyops lævidens, 602.
  mathewi, 602.
  monocomus, 602, 603.
  priscus, 601.
Limosa, 27.
Liobalæna, 291, 307.
  japonica, 291.
Liquidambar, 72.
  convexum, 94.
  europæum, 94.
  styraciflua, 94.
Lisconeura, 529.
  vexabilis, 523.
Lithagrion, 61–63.
  hyalinum, 63.
Lithogryllites **lutzii**, 54, 65.
Lithoryssus parvus, 523.
Lithymnetis guttatus, 64.
Lobipes, 20, 45.
Lomatia, 73, 74.
  abbreviata, 90.
  acutiloba, 90.
  hakeæfolia, 89.
  interrupta, 90.
  spinosa, 89.
  terminalis, 90.
  tripartita, 90.
Lomatites, 73, 89.
  berendtianus, 89.
  hakeæfolia, 89, 90.
  spinosa, 89, 90.
Loncheres (= Echimys) labilis, 651.
Lophiodon pumilus, 226, 232, 247.
Lophiotherium ballardi, 227, 248, 256.
  sylvaticum, 221, 226, 231, 255, 256.
  vasacciense, 222.
Lophodytes, 20.
Lophoproctus, 563, 566.
Lophortyx, 36.
Loxia, 36.
  cærulea, 35.
  erythrina, 32.
Lucæna **coloradensis**, 96.
Lunda, 36.
Lutra annectens, 661.
  canadensis, 661.
  latidens, 660.
Lygodium, 74.
Lysorophus tricarinatus, 531–533.

MACHETES, 20.
Macleayius britannicus, 302.
Macrocercus pachyrhynchus, 24.
Macromischa, 141.
  albispina, 139, 141.
  androsana, 142.
  cressoni, 141.
  iris, 142.
  isabellæ, 138, 141.
  lucayensis, 140, 141.
  lugens, 141.
  pastinifera, 140, 142.
  porphyrites, 142.
  pulchella, 138, 141.

Macromischa punicans, 141.
  purpurata, 142.
  sallei, 141.
  salvini, 141.
  splendens, 142.
  squamifera, 142.
  subditiva, 140, 141.
  versicolor, 141.
Macronectes, 20.
Macrorhamphus, 20.
Malvastrum, 72.
  exhumatum, 104.
Manacus superbus, 337.
Manicaria, 74.
Manteoceras manteoceras, 606.
  washakiensis, 607.
Mareca, 36.
Marila, 26.
Marmosa murina, 648.
  murina mexicana, 648.
Matthew, W. D., a four-horned Pelycosaurian from the Permian of Texas, 183–185; osteology of *Blastomeryx* and phylogeny of the American Cervidæ, 553–559.
Mazama, 557–559.
  nemorivaga, 547, 548, 550.
  tema, 649.
Megalestris, 20.
  catarrhactes, 20.
Megalohyrax eocænus, 272.
Megalopterus, 10.
Megapodagrion, 61, 62.
Megaquiscula, 36.
Megascops, 22.
Melanagrion, 61, 63.
  umbratum, 63.
Melanerpes, 20.
Melanitta, 36.
Meleagris, 36.
  gallopavo, 36.
Melia, 73.
  azedarach, 98, 99.
  expulsa, 98.
Mellinus **handlirschi**, 596.
Mellisuga minima, 31.
Melopelia, 36, 42–44.
Melophorus æneovirens 387.
  bagoti, 387.
Melophorus cowlei, 388.
Melospiza, 14.
Melothria, 72.
  coloradensis, 108.
  hirsuta, 108.
  pendula, 108.
Mephitis macroura vittata, 662.
Merganser, 44.
Mergellus, 20.
Mergus, 36.
  castor, 36.
  cucullatus, 20.
  merganser, 36.
Merula, 38, 44.
Mesatirhinus, 608, 609.
  megarhinus, 608, 610.
  petersoni, 604, **608**.
Mesoplodon bidens, 203–215.
  bowdoini, 203–215.
  europæus, 203–215.
  grayi, 206.
  hectori, 205.
Metachirus fuscogriseus, 648.
  nudicaudatus colombianus, 648.
Metarhinus, 609.
  diploconus, 610.
  earlei, 609, 610.
  fluviatilis, 609, 610.
Metaphiomys beadnelli, 270, 272.
Micrathene, 20.
Microdon tristis, 625.
Micropalama, 20, 43.
Micropallas, 20.
Microspirobolus **insularis**, 563, 572.
  marmoratus, 563, 571.
Micrura, 14.
Miller, W. DeWitt, a review of the Manakins of the genus *Chiroxiphia*, 331–343.
Mimetes, 20.
Mimosites, 72.
  linearifolius, 96.
  linearis, 96.
Mimulus, 72.
  guttatus, 107.
  saxorum, 107.
Mimus, 20.
Mniotilta, 20.
Mogoplistes, 64.

Molossus rufus, 670.
  verrilli, 581.
Molothrus, 20.
  robustus, 20.
Monomorium basalis, 126.
  carbonarium ebeninum, 127, 160, 169.
  destructor, 118, 126, 160.
  floricola, 118, 127, 160.
  fossulatum, 128.
  minutum, 127.
  minutum var. minimum, 423.
  omnivorum, 160.
  pharaonis, 118, 165, 422.
  pœcilum, 127.
  salomonis, 118.
  speculare, 127.
  subcœcum, 128.
Morella, 72.
  bolanderi, 81.
  hendersoni, 81.
Morphnus, 43.
Morus, 72.
  symmetrica, 88.
Moschus, 542.
Motacilla, 36.
  alba, 36.
  aurocapilla, 39.
  citrea, 23.
  flava, 15.
  mitrata, 40.
  protonaria, 23.
  regulus, 23.
  sialis, 39.
  suecica, 17.
  sutoria, 114.
  troglodytes, 21.
  varia, 20.
  vermivora, 12
Mus norvegicus, 657.
  rattus, 659.
  volans, 582, 583.
Muscicapa cayenensis, 14.
  ferox, 37.
  flammea, 114, 115.
  forficata, 14.
  noveboracensis, 40.
  olivacea, 40.
  rubrifrons, 16.
Muscicapa ruticilla, 39.
  virens, 21.
Muscivora, 14.
Mustela barbara, 587, 588, 589.
  galera, 588, 589.
Mutilla fulvescens, 408.
Myadestes, 20.
  genibarbis, 20.
Mycteria, 14, 20, 25, 44.
  americana, 20, 24.
Myiarchus, 37.
Myioborus, 14.
Myiochanes, 21.
Myiozetetes, 14.
Myrica, 72–74.
  acuminata, 81.
  amygdalina, 81.
  copeana, 81.
  diversifolia, 95.
  drymeja, 66, 74, 81.
  fallax, 81.
  obscura, 81, 108.
  polymorpha, 81.
  rigida, 81.
  scotti, 81.
  sp., 81.
  zachariensis, 81.
Myrmecia unispinosa, 126.
Myrmecina graminicola americana, 421.
  graminicola americana var. brevispinosa, 422.
  graminicola **texana**, 422.
  latreillei, 422.
Myrmecocysti, American, 345–397.
Myrmecocystus, 361–384.
  æneovirens, 346.
  bombycinus, 346, 351.
  melliger, 346–349, 351, 358, 382, 383.
  melliger **mendax**, 351, 352, 366, 383.
  melliger mendax var. **comatus**, 352.
  melliger **mimicus**, 353, 354, 363, 365, 367.
  melliger mimicus var. **depilis**, 354.
  melliger mimicus var. **jesuita**, 354.
  melliger **orbiceps**, 349, 351, 364, 383.
  melliger semirufus, 355, 367, 368.
  melliger semirufus var. testaceus, 355, 356.

Myrmecocystus mexicanus, 346, 347, 349, 356, 358, 362–364.
  mexicanus var. horti-deorum, 358, 369–380.
  mexicanus var. hortus-deorum, 358.
  mexicanus **mojave**, 360.
  mexicanus **navajo**, 360, 381, 382.
Myrmecophila, 64, 65.
Myrmecophiles, 625.
Myrmica alomaria, 126.
  atra, 423.
  basalis, 126.
  bicarinata, 143.
  caldaria, 143.
  cariniceps, 143.
  contigua, 127.
  domestica, 127.
  exigua, 430.
  fragilis, 127.
  kollari, 143.
  melanocephala, 150.
  minuta, 430.
  molesta, 430.
  ominosa, 126.
  pellucida, 150.
  reticulata, 143.
  rubra, 408.
  rubra brevinodis, 621.
  rubra scabrinodis, 621.
  scabronodis var. fracticornis, 621.
  simillima, 143.
  unifasciata, 127.
  vastator, 126.
Myrmicocrypta brittoni, 149.
Myrmilachista ambigua **ramulorum**, 155.
Myrsine, 72.
  antiqua, 105.
  laminarum, 105.

Nannus, 21.
Nasua narica bullata, 668.
Najadopsis, 73.
  regulosa, 79.
Necrodes **primævus**, 67.
Nehallenia irene, 60.
Neocorys, 21.
Neoponera villosa, 124, 403.
Neotoma **chrysomelas**, 653.
  ferruginea, 653.
  picta, 653.
Netta, 21.
Nettion, 21.
Neurotoma **cockerelli**, 521, 523.
  fasciata, 523.
Newportia ernsti, 563, 564.
Nichols, J. Treadwell, notes on two porpoises captured on a voyage into the Pacific Ocean, 217–219.
Nodosaurus, 195.
Nemonyx, 21.
Noordkaper, 283, 286, 288, 298.
Noortkaper, 310.
Nord-caper, 310.
Nordkapper, 310.
North Caper, 283, 286.
Nortonella, 592.
  typica, 593.
Notharctus vasacciensis, 222.
Nucifraga, 21.
Numenius, 27.
Nuttallornis, 21.
Nyctala, 14.
Nyctanassa, 21.
Nyctea, 27.
  erminea, 27.
Nycticorax, 27.
  europeus, 27.
Nyctidromus, 21.
  derbyanus, 21.
Nyctinomus brasiliensis musculus, 581.
Nylanderia imparis, 393.
Nymphalites **scudderi**, 67.
Nyroca, 27, 44.

Oceanites, 21.
  wilsoni, 21.
Oceanodroma, 21.
Ochelomyrmex auropunctatus, 144.
Octhodromus, 21.
Odocoileus, 549, 557–559.
Odontomachus clarus, 407.
  hæmatodes, 125, 126, 159, 407.
  hæmatodes var. ruginodis, 26.
  texana, 407.
Odontopeltis mauritii, 563.
Odostemon, 72.
  dictyota, 91.
  florissantensis, 91.
  repens, 91.
  simplex, 91.

Œnops, 32.
Ogmobalæna, 307.
Oidemia, 37.
Olbiorchilus, 21.
Oligotomus cinctus, 228, 231, 248, 249.
Olor, 37.
Onoclea, 72.
    reducta, 76, 108.
    sensibilis, 76.
    sensibilis fossilis, 76.
Onychoprion, 21.
Oporornis, 37.
Orchelimum placidum, 64.
Oreodontidæ, 561.
Oreopyra, 31.
    amethystina, 31.
    calolæma, 31.
    leucaspis, 31.
Oreortyx, 21.
Oreospiza, 21.
Oriolus ater, 20.
    baltimore, 40.
    banana, 37.
    caudacutus, 29.
    icterus, 27.
    phœniceus, 29.
    spurius, 37.
Ornismya clemenciæ, 17.
    costæ, 32.
    cyanopogon, 16.
    heloisæ, 32.
Ornithion, 22, 45.
    inerme, 22.
Orohippus, 230, 247, 262.
    agilis, 228, 231, 251, 257.
    angustidens, 223, 235.
    atavus, 253, 260.
    ballardi, 227, 228, 248–250, 260.
    cinctus, 228.
    cuspidatus, 223, 226, 235, 237.
    gracilis, 229.
    index, 222.
    major, 228, 229, 250, 260.
    procyoninus, 227.
    progressus, 250, 260.
    pumilus, 227, 230, 247, 249, 260.
    sylvaticus, 226, 227, 251, 256, 257.
    typicus, 227, **249**, 250, 260.
    uintanus, 228, 251, 255.
Orohippus uintensis, 229, 258.
    (Aminippus) agilis, 257, 260.
    (Aminippus) sylvaticus, 255, 260.
    (Aminippus) uintanus, 256.
Oroscoptes, 22.
Orotherium cristonense, 224, 237.
    index, 222, 234.
    lœvii, 225, 237.
    uintanum, 228, 230, 231, 255, 256.
Orpheus, 20.
    montanus, 22.
Ortalis, 37.
Orthomorpha coarctata, 563, 575.
Orthoporus sculpturatus, 563, 573.
Orthorhynchus amazili, 26.
Ortyx montezumæ, 34.
    pictus, 21.
    squamatus, 16.
Oryzomys, 656.
    alfaroi, 655, 657.
    alfaroi alfaroi, 655.
    alfaroi **incertus**, 655.
    carrikeri, 656, 657.
    costaricensis, 657.
    couesi, 655.
    devius, 655.
    gracilis, 657.
    ochraceus, 655, 656.
    talamancæ, 656, 657.
    velutinus, 657.
    villosus, 657.
    (Melanomys) chrysomelas, 654.
Osborn, Henry Fairfield, new fossil mammals from the Fayum Oligocene, Egypt, 265–272; new or little known Titanotheres from the Eocene and Oligocene, 599–617.
Osmanthus, 72.
    præmissa, 106.
Ossifraga, 20, 35.
Otocoris, 22.
Otocryptops melanostomus, 563, 564.
Otogyps, 11.
Otopterus waterhousii, 581.
Otostigmus caraibicus, 564.
Ototylomys **fumeus**, 658.
    phæus, 658.
    phyllotis, 658.
Otus, 11, 22, 44.

Otus bakkamæna, 22, 114, 116.
Oxydactylus, 559.
Oxyechus, 22.
Oxypolis, 72.
    destructis, 105.
    rigidus, 105.

PACHISTIMA, 72.
    canbiyi, 100.
    integra, 100.
Pachycondyla, 401.
    punctata, 123.
    stigma, 124.
    villosa, 124, 403.
Pachysylvia, 22.
Pagophila, 22.
Palæomeryx, 559.
Palæoscincus costatus, 191, 192.
Palæosyops borealis, 600.
    copei, 605.
    grangeri, 604.
    leidyi, 604.
    megarhinus, 608.
Paleotaxonus, 524.
    trivittatus, 522, **524**.
    typicus, 522, 525.
Paliurus, 73.
    florissanti, 102.
    haydeni, 102.
    orbicularis, 102.
Pallasicarbo, 22.
Palmecarpon, 72.
    globosum, 80.
Palœstrus oligocenus, 65, 66.
Pandion, 22.
Panorpa **arctiiformis**, 59.
    nuptialis, 59.
    picta, 59.
    rigida, 60.
Parabuteo, 22.
Paratrichia currens, 154.
Paratylopus, 539.
Paremphytus, 526.
    ostentus, 522.
Parra variabilis, 15.
    jacana, 27.
Parthenocissus **osborni**, 103.
Parus, 37.
    americanus, 33.
Parus bicolor, 15.
    fasciatus, 15.
    lugubris, 22.
    major, 37.
Passer, 27.
    domesticus, 27.
Passerculus, 37.
Passerella, 22.
Passerherbulus, 31.
Passerina, 37, 42–45.
Pastor, 38.
Pavoncella, 20, 45.
Pediœcetes, 22.
Pelagodroma, 22.
Pelecanus, 37.
    aquilus, 18.
    bassanus, 34.
    carbo, 27.
    erythrorhynchus, 17.
    fuscus, 20.
    onocrotalus occidentalis, 20
    sylvestris, 20.
    trachyrhynchus, 17.
    urile, 28.
Pelidna, 37.
Pelionetta, 22.
Pellæa, 72.
    antiquella, 77.
    stelleri, 77.
Pendulinus, 37.
Penthestes, 22.
Perdix, 114.
    bicalcarata, 114.
    bicalcaratus, 115.
Persea, 72.
    coloradica, 91.
Persecaria, 72.
    amphibia, 91.
    tertiaria, 90.
Perisoreus, 37.
Peristera rufaxilla, 20.
Peromyscus **nicaraguæ**, 658.
    nudipes, 659.
Peropteryx canina, 669.
Peucæa, 37.
Peucedramus, 22.
Phaethon, 37.
    æthereus, 37.
Phainopepla, 22.

Phalænoptilus, 22.
Phalacrocorax, 27.
  bicristatus, 28.
  perspicillatus, 22.
Phalaropus, 44, 45.
Phaleris, 15, 37, 44, 45.
  nodirostris, 16.
Phasianus motmot, 37.
Phegopteris, 72.
  dryopteris, 72.
  guyottii, 76.
Pheidole **barbata**, 448.
  bicarinata, 453.
  carbonaria, 433.
  casta, 454.
  ceres, 437, 440.
  cockerelli, 464.
  colombica, 133.
  commutata, 460.
  constipata, 468, 469.
  cornutula, 455.
  crassicornis var. **diversipilosa**, 467.
  crassicornis **porcula**, 466.
  crassicornis porcula var. **tetra**, 467.
  dentata var. commutata, 460.
  desertorum, 460.
  desertorum var. comanche, 460.
  desertorum var. maricopa, 460.
  dimidiata, 137.
  emilæ, 133.
  emilæ var. retifera, 133.
  fallax, 132, 133, 161.
  fallax jelskii var. antillensis, 133, 161.
  fallax jelskii var. arenicola, 133.
  flavens exigua, 134, 137.
  flavens sculptior, 134.
  humeralis, 456.
  hyatti, 462, 465.
  hyatti var. **ecitonodora**, 463.
  kingi instabilis, 431, 442.
  lamia, 477.
  lauta, 470.
  macclendoni, 450.
  marcidula, 457.
  megacephala, 118–121, 133, 161.
  metallescens **splendidula**, 474, 475.
  mœrens, 136, 137.
Pheidole morrisi var. **impexa**, 461.
  nuculiceps, 473, 474.
  orbica, 137.
  pilifera coloradensis, 434–437.
  pinealis, 459.
  proserpina, 437, 440.
  punctatissima **jamaicensis**, 161.
  radoszkowskii var. opacissima, 161.
  rhea, 452, 462.
  rugifrons, 433.
  sciophila, 443.
  sitarches, 440.
  sitarches **rufescens**, 443.
  sitarches rufescens var. **campestris**, 443.
  sitarches var. **transvarians**, 442.
  soritis, 439, 442.
  subarmata, 455.
  subarmata var. **borinquenensis**, 133.
  tepicana, 433.
  texana, 464.
  titanis, 461.
  tysoni, 455.
  vinelandica, 453, 460.
  vinelandica **buccalis**, 454.
  vinelandica var. longula, 453.
  xerophila, 446, 447, 448.
  xerophila, **tucsonica**, 448.
  xerophila tucsonica var. **gilvescens**, 448.
Phenacolestes **mirandus**, 61–63.
  parallelus, 62.
Phenacoperga, 527.
  coloradensis, 523.
Philacte, 22.
Philadelphus, 72.
  coronarius, 92.
  inodorus, 92.
  palæophilus, 92.
Philohela, 22.
Phiomys, 269.
  andrewsi, 269, 270.
Phlœotomus, 22.
Phœbastria, 22.
Phœbetria, 22.
Phœnicophaus pyrrhocephalus, 114.
Phœnicopterus, 23.
  ruber, 23.
Phora **cockerelli**, 274.

Phora copalina, 273.
    ethiopica, 273.
    laminarum, 275.
    multiseriata, 275.
Phyllites cyclophyllus, 108.
Phyllopneuste borealis, 28.
Phymatodes dimidiatus, 68.
    varius, 68.
    volans, 68.
Pica, 28.
    pica, 28.
Picea, 72.
Picicorvus, 23.
Picoides, 37.
Picus carolinus, 16.
    erythrocephalus, 20.
    lineatus, 14.
    miniaceus, 114, 116.
    miniatus, 115, 116.
    pileatus, 22.
    principalis, 16.
    pubescens, 10, 18.
    torquatus, 15.
    tridactylus, 37.
    varius, 14.
Pinguinus, 43.
Pinicola, 23.
    rubra, 23.
Pinus, 72.
    flexilis, 78.
    florissanti, 78.
    hambachi, 78.
    wheeleri, 78.
Pipilo, 23.
Pipra caudata, 340.
    fastuosa, 332.
    ignicapilla, 340.
    lanceolata, 334.
    linearis, 332.
    longicauda, 340.
    musica, 34.
    pareola, 337.
    pareoloides, 334.
    viridis, 340.
Piranga, 23.
    rubra, 23.
Pison **cockerelli**, 519.
    oligocenum, 420.
Pitangus, 23.
Plagiolepis allaudi, 166.
    brunni, 167.
    exigua, 166.
    flavidula, 153.
    longipes, 165, 166.
    mactavishi, 165, 166.
    obscura, 169, 170.
    pygmæa, 166.
    trimeni, 389.
Planera, 72.
    longifolia, 83–85, 88, 90.
    myricæfolia, 87, 88.
    ungeri, 88.
Planesticus, 37, 44.
Plantanus, 83.
    dissecta, 84.
    rhomboidea, 84.
Platalea ajaja, 15.
    pygmæa, 18.
Platypsaris, 14.
Platyrhynchus cinereus, 21.
Platythyrea inconspicua, 123.
    pruinosa, 123.
    punctata, 123.
Plautus, 10, 23, 43.
Plegadis, 23.
Plectrophenax, 23.
Pliauchenia, 559.
Plotus, 15.
    anhinga, 15.
Poacites, 74.
Podasocys, 23.
Podiceps, 45.
    occidentalis, 15.
Podilymbus, 23.
Podogonium, 73.
    americanum, 73.
    acuminatum, 97.
Polacanthus, 193.
Polioptila, 38.
Polyborus, 23.
Polygonum amphibium, 90.
    tertiarium, 90.
Polysticta, 23.
Polystœchotes **piperatus**, 59.
Ponera americana, 124.
    bicolor, 124.
    coarctata pennsylvanica, 404, 621.
    contracta, 405.

Ponera eduardi, 169, 170.
  elongula, 406.
  ergatandria, 405.
  fœda, 404, 405.
  gilva, 406.
  inexorata, 406.
  opaciceps, 404, 405.
  perkinsi, 165.
  predunculata, 124.
  quadridens, 123.
  quadridentata, 124.
  stigma, 124.
  texana, 406.
  trigona var. opacior, 405.
Poœcetes, 23.
Populus, 72, 73.
  alba, 83.
  arctica, 83.
  arctica decipiens, 82, 83.
  bolleana, 83.
  crassa, 81, 82.
  daturæfolia, 83.
  lesquereuxi, 71, 82, 90.
  oxyphylla, 82.
  pseudocredenaria, 82.
  pyrifolia, 82.
  scudderi, 82.
  subrotundata, 83.
  zaddachi, 82.
Porana, 73.
  macrantha, 107.
  œningensis, 107.
  racemosa, 107.
  speirii, 107.
  tenuis, 107.
Porzana, 23.
Potamogeton, 72.
  geniculatus, 79.
  verticellatus, 79.
Potos flavus aztecus, 662.
Prenolepis bruesi, 386.
  fulva, 162.
  longicornis, 118–121, 154, 162, 165, 167.
  melanderi, 154, 386.
  nodifera, 154.
  obscura, 165.
  obscura vaga, 167.
  parvula, 386.
Prenolepis steinheili, 154.
  vividula, 154.
  (Nylanderia) imparis, 385.
Priocella, 23.
  garnottii, 23.
Priofinus, 38.
Procellaria, 11, 25, 38, 42, 45.
  æquinoctialis, 11, 38.
  antarctica, 35.
  bullweri, 15.
  capensis, 14.
  cinerea, 38.
  furcata, 21.
  gigantea, 20, 35.
  glacialis, 11, 34.
  glacialoides, 23.
  gralleria, 14.
  hasitata, 29.
  leucorrhoa, 14.
  marina, 22.
  pelagica, 11, 25.
  puffinus, 28.
Proceratum croceum, 401.
Productus, 54.
  borealis, 55.
  costatus, 55.
  fimbriatus, 55.
  horridus, 54.
  longispinus, 55.
  longispinus var. wabashensis, 56.
  mesolobus, 55.
  pseudolineatus, 54.
  semireticulatus, 54.
  semireticulatus **arctica**, 54, 55.
  sulcatus, 55.
  sulcatus var. borealis, 55.
  verneuilianus, 55, 56.
  weyprechti, 55.
Prodremotherium, 559.
Proebrotherium, 559.
Proechimys centralis, 649, 651.
Progne, 23.
Pronemobius, 64.
Protitanotherium **superbum**, 615.
Protoceras, 559.
Protonotaria, 23.
Protorohippus venticolus, 232, 245, 261.
Psaltriparus, 23.
  personatus, 23.

Psarocolius æneus, 24.
  cyanocephalus, 18.
Pseudocimbex, 526.
  clavatus, 521, 523, 527, 528.
Pseudodichthadia incerta, 408.
Pseudodontalus leucocephalus, 114.
Pseudolabis, 559.
Pseudomyra brunnea, 420.
  delicatula, 160.
  delicatula var. capperi, 160.
  elongata, 160.
  flavidula, 126, 160, 419, 420.
  gracilis var. mexicana, 421.
  pallida, 419, 420.
Pseudophæa, 62.
Pseudosiobla, 524.
  excavata, 525.
  megoura, 522, 525.
Psittacara, 33, 34.
Psittacus carolinensis, 17, 33.
  cruentatus, 34.
  guianensis, 33, 34.
  leucophthalmus, 33, 34.
  rufirostris, 33.
  torquatus, 33.
  vittatus, 33, 34.
Ptelea, 72.
  modesta, 98.
Pterobalæna, 307.
Pterocarya, 73.
  americana, 80.
Pteromys russicus, 583.
Pteronus prodigus, 523.
Ptolemaïa, 267.
  lyonsi, 268.
Ptolemaiidæ, 267.
Ptychoramphus, 23.
Puffinus, 28.
  puffinus, 28.
Putorius tropicalis, 661.
Pyramica gundlachi, 145.
Pyrgita, 27.
Pyrocephalus, 38.
Pyrrhula, 28.
  cinereola, 39.
  falcirostris, 38, 39.
  pyrrhula, 28.
Pyrrhuloxia, 23.
Pyrrhura, 33, 34.

QUERCUS, 72, 74, 83, 84.
  acrodon, 86.
  cinerea, 366.
  balainorum, 85, 86.
  drymeja, 85.
  elæna, 85.
  emoryi, 86.
  florissantensis, 85.
  gambeli, 378.
  horniana, 87.
  lesquereuxiana, 86.
  lyrata, 85.
  lyratiformis, 85.
  mediterranea, 85.
  neriifolia, 85, 89.
  osbornii, 85.
  peritula, 85.
  prinoides, 86.
  pyrifolia, 85.
  ramaleyi, 85.
  serra, 85, 86.
  undulata, 376, 378, 386.
Querquedula, 28.
Quiscalus, 28.

RALLUS, 38.
  aquaticus, 38.
  crex, 17.
  jamaicensis, 17.
Rangifer, 557.
  arcticus, 487–489.
  grœnlandicus, 487–489.
  pearyi, 487–504.
Ratufa macroura, 114.
Regulus, 23.
Recurvirostra, 23.
  avocetta, 23.
Reithrodontomys, 654.
  modestus, 654.
Reticularia lineatus, 56.
Rhamnus, 72.
  caroliniana, 102.
  florissantensis, 102.
  frangula, 102.
  kirchneri, 102.
  oleifolius, 102.
  oleœfolius, 102.
  washakiensis, 74.
Rhantistes, 23, 35, 44.

Rhinocricus arboreus, 569.
    arboreus var. gundlachi, 563, 569.
    modestior, 570.
    parcus, 570.
Rhinogryphus, 32.
Rhipidomys salvinii, 658.
Rhodostethia, 24.
Rhopalothrix simoni var. **wighti**, 161.
Rhua hilliæ, 99.
Rhus, 72, 74, 95, 96.
    acuminata, 94, 99.
    coriarioides, 96, 99.
    haydenii, 93.
    incissa, 94.
    rosæfolia, 94, 99.
Rhynchiscus naso, 669.
Rhynchodon, 38.
Rhynchofalco, 24.
Rhynchonelloides, 56.
Rhynchophanes, 24.
Rhynchopsitta, 24.
Ribes, 72.
    hudsonianum, 93.
    nigrum, 93.
    protomelænum, 93.
Riparia, 24.
    europæa, 24.
Rissa, 24.
    brunnichii, 24.
Rogeria curvipubens, 142.
    foreli, 143.
Rohwer, S. A., the Tertiary Tenthredinoidea of the Expedition of 1908 to Florissant, Colorado, 591–595; a fossil Mellinid Wasp, 596; a fossil Larrid Wasp, 519, 520; on the Tenthredinoidea of the Florissant Shales, 521–530.
Rosa, 72.
    hilliæ, 95, 99.
    sayi, 94.
    setigera, 95.
    wilmattæ, 94, 95.
Rostrahamus, 24.
    niger, 24.
Rusticola, 38.

SABAL, 74.
Sabina, 72.
Sabina linguæfolia, 79.
Salix, 72, 74, 82.
    amygdalæfolia, 82.
    integra, 82.
    libbeyi, 82.
    media, 82.
    ramaleyi, 82.
    ramaleyi **rohweri**, 82.
Salpinctes, 38.
Santalum americanum, 90.
Sapindus, 72–74.
    angustifolius, 101.
    coloradensis, 101.
    drummondi, 101.
    inflexus, 102.
    lancifolius, 102.
    leonis, 102.
    stellariæfolius, 101.
Sarcidiornis melanonota, 114.
Sarcorhamphus, 11, 35, 38.
Sarda, 282, 284, 286, 310.
Sarde, 280, 299.
Saurothera california, 19.
Saxicava rugosa, 57, 58.
Saxicola, 38.
Saxifraga (?) **peritula**, 92.
Sayornis, 24.
Scardafella, 38.
Scelidosaurus, 192–194, 196.
Schizocerus **konowi**, 591.
Schmaltzia, 72.
    vexans, 99.
Sciuropterus, 582.
    (Glaucomys) volans, 582.
Sciurus boothiæ belti, 659.
    deppei deppei, 660.
    deppei **matagalpæ**, 660.
    griseoflavus, 659, 660.
    macrourus, 114.
    richmondi, 660.
Scolecophagus, 18.
Scolioneura vexabilis, 529.
Scolopax, 38.
    arquata, 20.
    gallinago, 27, 38.
    griseus, 20.
    incanus, 19.
    limosa, 27.
    nebularius, 27.

Scolopax ruber, 19.
    rusticola, 38.
    totanus, 28.
Scops, 22.
Scotiaptex, 39.
Scrag-whale, 295.
Seiurus, 39.
Selasphorus, 39.
Septemoda etsagica, 225, 238
Sequoia, 72–74.
    affinis, 73, 78.
    gigantea, 78.
    haydeni, 78.
    sempervirens, 78.
Setophaga, 39.
    rubra, 18.
    verticalis, 14.
Sialia, 39.
Sicyos, 72.
    angulatus, 107.
    florissantia, 107.
Sigmodon hispidus borucæ, 657.
    hispidus **griseus**, 657.
    littoralis, 657.
Silvestri, Filippo, Myriopoda from Porto Rico and Culebra, 563–578.
Simorhynchus, 15.
Siphonophora portoricensis, 563, 566.
Sitta, 24.
    europæus, 24.
Sletbag, 283, 310.
Solenodon cubanus, 507, 509, 510, 512–517.
    paradoxus, 505–517.
Solenopsis, 110.
    azteca var. **pallida**, 131, 160.
    corticalis, 131.
    debilis, 429.
    geminata, 424.
    geminata aurea, 425.
    geminata var. **diabola**, 424.
    geminata rufa, 165.
    globularia, 130.
    globularia var. **borinquenensis**, 131.
    krockowi, 428.
    molesta, 429.
    molesta var. validiuscula, 430
    picea, 131.
    pilosula, 426.
    pollux var. texana, 430
Solenopsis **salina**, 427.
    sulphurea, 131.
    texana, 430.
    xyloni, 424.
Somateria, 24.
Sorbus, 72.
    megaphylla, 95.
Spatula, 24, 31.
Speotyto, 24.
Spermophila, 39.
Sphærites, 74.
Sphenopteris guyottii, 76.
Sphyrapicus, 14.
Spilogale angustifrons elata, 662.
Spilotreron melanocephala, 114.
Spinus, 28.
Spirifer, 51, 25.
    aldrichi, 52.
    attenuata, 54.
    cameratus, 52, 54.
    cristata, 53.
    duplicicosta, 53.
    fasciger, 53.
    gramulifera, 52.
    grimesi, 52.
    laminosa, 53.
    lineatus, 53, 54.
    octoplicata, 52.
    pennatus, 52.
    pseudolineatus, 54.
    striata, 54.
Spirobolus multiporus, 563, 571.
Spirodela, 72.
    pencillata, 79.
Spiza, 39.
Spizella, 24.
Spodesilaura, 18.
Sporophila, 39
Squatarola, 28
Staphylea, 72.
    acuminata, 101.
Starnœnas, 24.
Steganopus, 24.
Stegosaurus, 196.
Stelgidopteryx, 24.
Stellaria, 23.
Stellula, 24.
Stenanna (Aphænogaster) fulvum var. piceum, 621.
    (Aphænogaster) mariæ, 643.

Stenomylus, 559.
Stercorarius, 28.
  stercorarius, 28.
Sterculia, 73.
  rigida, 104.
Stereocephalus, 187, 188.
  tutus, 197.
Sterna cantiaca, 10, 14.
  caspia, 10.
  leucoptera, 36.
  nigra, 10, 36.
  nilotica, 19.
  stolida, 10.
Sternula, 24.
Stigmatomma pallipes, 399, 400.
Stipa, 72.
  comata, 79.
  laminarum, 79.
Streptoceryle, 39.
Streptorhynchus, 51, 52.
Strix, 39.
  aluco, 24.
  asio, 22.
  bakkamœna, 114.
  bubo, 26.
  cinerea, 39.
  cunicularia, 24.
Strumigenys, 146.
  alberti, 148.
  clypeata, 148.
  clypeata var. pilinasis, 146.
  conspersa, 148.
  cordovensis, 147.
  crassicornis, 146.
  cultrigera, 147.
  denticulata, 146.
  eggersi, 145, 146.
  eggersi var. vincentensis, 146.
  elongata, 146.
  frederic-muelleri, 148.
  fusca, 147.
  godmani, 147.
  gundlachi, 146.
  imitator, 146.
  lanuginosa, 147.
  louisianæ var. longicornis, 147.
  louisianæ var. **obscuriventris**, 145, 147.
  magaritæ, 148.
Strumigenys mandibularis, 146.
  membranifera simillima, 144, 148.
  ornata, 148.
  pergandei, 148, 149.
  pulchella, 148.
  rogeri, 145, 147.
  rostrata, 148.
  saliens, 147.
  saliens var. procera, 147.
  schmalzi, 148.
  schulzi, 148.
  silvestrii, 148.
  smithi, 146.
  smithi procipiens, 147.
  smithi var. inæqualis, 147.
  subedentata, 146.
  unidentata, 147.
Sturnella, 24.
Sturnus, 39.
Sula, 28.
Surnia, 24.
Sylochelidon, 10.
Sylvia agilis, 37.
  coronata, 17.
  ludoviciana, 25.
  olivacea, 22.
  rubricapilla, 35.
  swainsoni, 35.
  vermivora, 15, 19.
Sylvicola decurtata, 22.
Symborodon **copei**, 616.
Symphemia, 18.
Syndyoceras, 559.
Synthlyborhamphus, 39.
Syrichtha, 21.
Syringothyris, 51, 52, 53.
  arctica, 57.
Syrnium, 24.
  ululans, 24.

TACHYBAPTUS, 24.
Tachycineta, 39.
Tachytriorchis, 24.
Tadorna, 26.
Tamandua tetradactyla chiriquensis, 648.
Tanagra cyanea, 37.
Tangavius, 24, 44.
  involucratus, 24.
Tantalus, 25, 45.

Tantalus leucocephalus, 114.
  loculator, 20, 25.
Tapinoma littorale, 150.
  melanocephalum, 118, 150, 162, 165, 166.
Tatu novemcinctus, 649.
Tayra, 662.
  barbara **inserta**, 662.
Technomyrmex albipes, 165, 166.
Tenthredo misera, 525.
  saxorum, 594.
Telmatherium **altidens**, 614.
  cornutum, 611.
  ultimum, 613.
Tetraceratops, 183.
  insignis, 183–185.
Tetragmus caldarius, 43.
Tetramorium auropunctatus, 143, 144.
  cæspitum, 169.
  cariniceps, 143.
  guineense, 118, 143, 161.
  kollari, 143.
  pacificum, 165.
  simillimum, 118, 143.
Thalassœca, 35.
Thalasseus, 10.
  cantiaca, 10.
Thalassogeron, 25.
Thalassarche, 25.
Thalassidroma, 11, 25.
  leucogastra, 14.
Thrassaetos, 25.
Thryomanes, 25.
Thryothorus, 25.
  mexicanus, 16.
Thuja, 73.
Tiaris, 30, 44.
Tilia, 75.
  populifolia, 88.
Tinnunculus, 40, 42.
Tipula maclurei, 66, 67.
Tmesipteris, 73.
  alleni, 75, 77, 99.
Torda, 10, 23.
Totanus, 28.
  glottis, 27.
Toxostoma, 25.
  vetula, 25.
Tragulidæ, 561.
Tragulus, 553, 554.
Triceratops, 199.
Trichas, 35.
Trichiosomites, 526.
Tridesmus **portoricensis**, 577.
Trigonolestidæ, 561.
Tringa, 40.
  alpina, 37.
  arenaria, 16.
  autumnalis, 23.
  bartramia, 15.
  canutus, 40.
  ferruginea, 18.
  fulicaria, 27.
  himantopus, 20.
  interpres, 15.
  lobata, 20.
  longicauda,
  maritima, 15.
  minuta, 14.
  ochropus, 19.
  pugnax, 20.
  pusilla, 18.
  squatarola, 28.
  subruficollis, 25.
  virgata, 15.
Trochilus, 12, 42–43, 45.
  alexandri, 12.
  colubris, 12.
  fulgens, 18.
  franciæ, 40.
  leucotis, 32.
  lucifer, 16.
  polytmus, 12, 40.
  rufus, 39.
Trogon, 25.
  fasciatus, 114.
  strigilatus, 25.
  viridis, 25.
Troglodites, 21, 40.
Troglodytes, 21, 42.
  aedon, 40.
  arundinaceus, 25.
  bewickii, 25.
  obsoletus, 38.
  stellaris, 33.
Troödon, 187.
  formosus, 192.
Tryngites, 25.

Turdus, 40.
  cinclus, 17.
  felivox, 17.
  jamaicensis, 37.
  merula, 38.
  mustelinus, 14.
  nævius, 19.
  polyglottos, 20.
  roseus, 38.
  trichas, 35.
  virens, 19.
  viscivorus, 40.
Tursiops, 217.
  gillii, 218.
  truncatus, 218–219.
Tympanuchus, 25.
  cupido, 25.
Typha, 72, 74.
  latifolia, 75.
  lesquereuxi, 78, 79.
Typhlopone pallipes, 399.
Tyrannosaurus, 199.
Tyrannus, 28.
  borealis, 21.
Tyrannula curtipes, 21.
  nigricans, 24.
  pusilla, 18.
  saya, 24.

ULMUS, 72, 74.
  braunii, 88.
  brownelli, 87.
  hilliæ, 87, 88.
  tenuinervis, 87, 88.
Uranomitra, 40.
Uria, 28.
  pusilla, 16.
Urubitinga, 25, 43.
Urile, 28.
Urocyon cinereoargenteus guatemalæ 668.
  parvidens, 668.
Urogallus, 28.

VACCINIUM, 72.
  ovafolium, 105.
  reticulatum, 105.
  retigerum, 105.
Vanellus, 28.
Vermivora, 19, 30.
Viborquia, 97.
  adenostylis, 97.
  nigrostipellata, 97.
  orthocarpa, 97, 98.
  polystachya, 97.
  spinosa, 97, 98.
Victima missourensis, 484.
Vireo flavifrons, 14.
Vitis, 72.
  alaskana, 103.
  cinerea, 103.
  florissantella, 102, 103.
  olriki, 103.
  rotundifolia, 103.
  rupestris, 103.
  sparsa, 103.
  vinifera, 102.
Vultur, 11.
  aura, 11, 32.
  auricularis, 11.
  californianus, 19.
  cinereus, 11.
  gryphus, 11.
  harpyia, 25.
  monachus, 11.
  papa, 11, 35, 38.
  urubu, 32.

WAGELLUS, 11.
Wasmannia auropunctata, 143, 144, 161.
Weinmannia, 72, 95.
  dubiosa, 94.
  haydenii, 93.
  integrifolia, 93.
  lesquereuxi, 93, 94.
  obtusifolia, 93.
  phenacophylla, 93.
  rosæfolia, 94, 95.
  sylvicola, 94, 95.
Whale, Atlantic Right, 310.
  Bearded, 282.
  Black, 310.
  Grand-bay, 282.
  Greenland, 282, 288.
  North Atlantic Right, 277–329.
  Right, or Whalebone, 284, 310, 319
  Seven-feet-bone, 310.
  True, 310.

Whale, Whalebone, 310.
Wheeler, William Morton, the ants of Porto Rico and the Virgin Islands, 117–167; honey ants, with a revision of the American *Myrmecocysti*, 345–394; the ants of Texas, New Mexico and Arizona, 399–484.
Whitfield, R. P., notes and observations on Carboniferous fossils and semifossil shells, brought home by members of the Peary Expedition of 1905–1906, 51–58.
Wilsonia, 40.
Woodwardia, 72.
    areolata, 77.
    florissantia, 77.
    preareolata, 77.

XANTHOCEPHALUS, 25.
    perspicillatus, 25.
Xanthoura, 40.
Xema, 25.
Xenopicus, 25.
Xipholena, 12.
Xiphorhynchus, 31.
Xiphornis, 30.

YPHANTES, 40.

ZAMELODIA, 25.
Zenaida, 28.
Zenaidura, 25.
Zizyphus, 72, 74.
Zonotrichia, 40.

AMERICAN MUSEUM OF NATURAL HISTORY.

DEPARTMENT OF VERTEBRATE PALÆONTOLOGY.

LIST OF PHOTOGRAPHS AND LANTERN SLIDES OF FOSSIL VERTEBRATES FOR SALE OR EXCHANGE.

REVISED TO MAY, 1908.

The mounted skeletons and restorations of fossil vertebrates in the American Museum of Natural History, prepared under the direction of Professor Henry Fairfield Osborn, are represented by excellent photographic negatives, from which lantern slides, photographic prints, and bromide enlargements may be ordered for scientific and Museum purposes, but not for publication. *Unpublished* photographs and lantern slides of the restorations and skeletons are sold only with the understanding and agreement that they are not to be used for publication without express permission.

In reproducing the *published* prints acknowledgment should be made by placing after the title or description: "After —," (= name of author who first published the original photograph or drawing), and "Original in the American Museum of Natural History."

The well known restorations of fossil vertebrates by Charles R. Knight were prepared under Professor Osborn's personal supervision and represent his views as to the probable appearance, life habits and natural surroundings of the animals. Many of the photographs of mounted skeletons (especially the platinum prints) are of great beauty and represent the skeleton without the mounting.

Most of the subjects listed below are represented by both 8 × 10 and 10 × 11 inch negatives; a few only by 6½ × 8½ inch negatives.

Price List.

Lantern slides	3¼ × 4 in.	$ .50	each
" "	3¼ × 3¼ in. English size	.50	"
Photographic prints mounted	6½ × 8½ in.	.75	"
" " "	8 × 10 in.	1.00	"
" " "	11 × 14 in.	2.00	"
" " "	8 × 10 in. platinum tone	1.25	"
" " "	11 × 14 in.	2.25	"
Bromide enlargements "	11 × 14 in.	3.00	"
" " "	18 × 22 in.	4.00	"

FISHES.

Dinichthys terrelli. A large Arthrodiran "fish" with piercing and shearing mouth parts, from the Devonian of Ohio.

Mounted skull, Neg. 47 (8 × 10 in.). Right of reproduction reserved.

Titanichthys clarkii. The biggest of the Arthrodiran "fishes" — Upper Devonian, Ohio.

Skull, slab-mount, top view. Neg. 1004 (11 × 14 in.). Not published. Right of reproduction reserved.

Portheus molossus. A sixteen foot fish from the Cretaceous of Kansas.

Neg. 72, with Tarpon (8 × 10 in.).

Neg. 73, with Tarpon (11 × 14 in.).

Neg. 75–78 (conjoined), about 3 feet 6 inches long and 13 inches wide; price, $10.00.

Published; credit to American Museum and Henry Fairfield Osborn.

REPTILES.

Stereosternum tumidum. A small aquatic reptile of the extinct order Proganosauria. Permian, Brazil.

Skeleton in slab, Neg. (8 × 10 in.); Neg. (11 × 14 in.).

Restoration, Neg. — (8 × 10 in.).

Published; credit to J. H. McGregor.

Naosaurus claviger. A predatory reptile of the extinct order Pelycosauria with the back surmounted by a fin-like series of elongate neural spines. Permian, Texas.

Mounted skeleton, side view, Neg. 837 (8 × 10 in.); Neg. 836 (11 × 14 in.).

Mounted skeleton, three quarters view, Neg. 832 (8 × 10 in.); Neg. 836 (11 × 14 in.). Model, Neg. 829 (8 × 10 in.). All published; credit to American Museum and Henry Fairfield Osborn.

Backbone, with ribs and girdles. Neg. 1076 (8 × 10 in.); 1077 (11 × 14 in.). Not published; right of reproduction reserved.

Dimetrodon incisivus. This genus of Pelycosaurs differed from *Naosaurus* in the shape of the long neural spines of the vertebræ, which ended in delicate rods, and lacked cross bars.

Skull, backbone and ribs, side view, Neg. 1074 (8 × 10 in.); Neg. 1075 11 × 14 in. Not published; right of reproduction reserved.

Champsosaurus laramiensis. A small gavial-like aquatic reptile from the Upper Cretaceous of Montana; allied to the Sphenodon or rock-lizard of New Zealand.

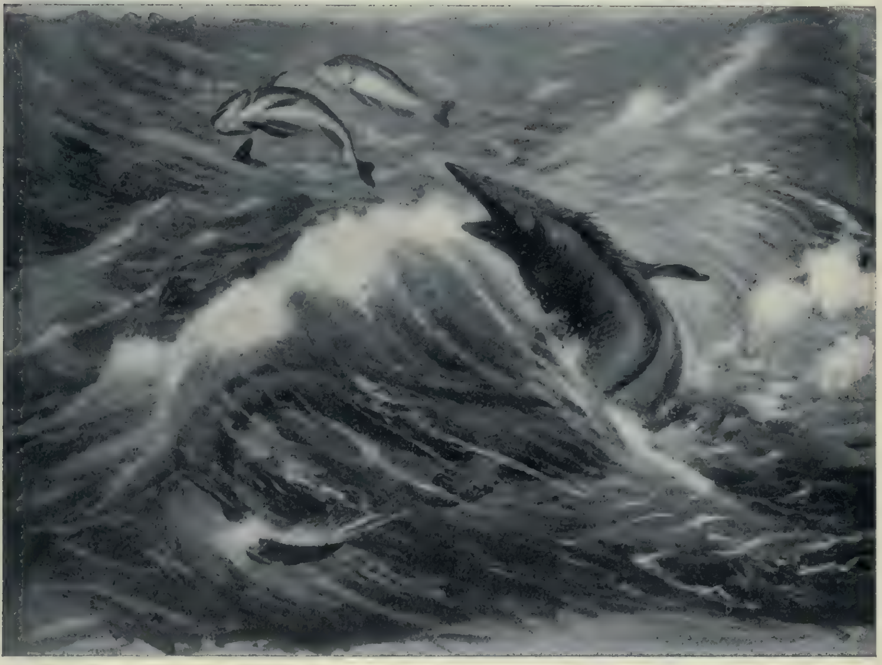


Fig. 1. Restoration of a thirty-foot marine lizard (*Tylosaurus dyspelor*) from the Cretaceous of Kansas. By Charles R. Knight.

Right of reproduction reserved.

Mounted skeleton, side view, Neg. 91A (8 × 10 in.); Neg. 91B (11 × 14 in.).
Mounted skeleton, top view, Neg. 90A (8 × 10 in.); Neg. 90B (11 × 14).
Published; credit to American Museum and Barnum Brown.

Ichthyosaurus quadriscissus. Skeleton, with remains of seven supposedly unborn young. Jurassic, Germany.

Skeleton in slab, Neg. 96 (8 × 10 in.); Neg. 97 (11 × 14 in.). Neg. 94, 95 conjoined (11 × 28 in.), price $5.00.
Restoration, Neg. R30A.
Published; credit to American Museum and Henry Fairfield Osborn.

Tylosaurus dyspelor. A marine lizard of the order Mosasauria, about 30 feet long.

Skeleton in slab, Neg. 101 (6½ × 8½ in.). Published; credit to American Museum and Henry Fairfield Osborn.
Restoration, Neg. R25 (8 × 10 in.). Not published, right of reproduction reserved.

Elasmosaurus platyurus. The restoration represents Professor Cope's idea of the appearance of this Upper Cretaceous Plesiosaur, but the extreme sigmoid curvature of the neck may be exaggerated.

Restoration, Neg. R14 (8 × 10 in.). Published; credit to American Museum and Henry Fairfield Osborn.

Ornitholestes hermanni. A small carnivorous dinosaur called the "Bird-catching Dinosaur."

Mounted skeleton, Neg. 116 (8 × 10 in.); Neg. 115 (11 × 14 in.).
Restoration, Neg. R42 (8 × 10 in.).
Published; credit to American Museum and Henry Fairfield Osborn.

Allosaurus fragilis. The skeleton of this predatory dinosaur is mounted in life-like pose, as if feeding upon the carcass (here represented by a partial skeleton) of a Brontosaurus.

Mounted skeleton, Neg. 1086 (8 × 10 in.); Neg. 1087 (11 × 14 in.). Not published; right of reproduction reserved.
Skull, Neg. 125 (8 × 10 in.).
Restoration, Neg. R28B (8 × 10 in.).
Published; credit to American Museum and Henry Fairfield Osborn.

Tyrannosaurus rex. The last and greatest of the carnivorous dinosaurs. Upper Cretaceous, Montana. The restoration also represents the three-horned dinosaur Triceratops.

Mounted pelvis and legs, Neg. 1088 (8 ×10 in.); Neg. 1089 (11 × 14 in.).
Mounted skull, Neg. 1091 (8 × 10 in.).
Restoration, Neg. R51 (8 × 10 in.). Not published; right of reproduction reserved.

Brontosaurus excelsus. The mounted skeleton of this great amphibious dinosaur measures 67 feet along the curve of the backbone. Upper Jurassic, Wyoming.

Mounted skeleton, Neg. 1094 (8 × 10 in.); Neg. 1095 (11 × 14 in.). Right of reproduction reserved.

Model, Neg. 149 (8 × 10 in.).

Restoration, Neg. R24 (8 × 10 in.). Published; credit to American Museum and Henry Fairfield Osborn.

Diplodocus longus. This dinosaur was larger and more slender than the Brontosaurus. The skull was even smaller and quite different in proportions. Upper Jurassic, Wyoming.

Model, Neg. 190 (8 × 10 in.).

Restoration, Neg. R29 (8 × 10 in.).

Published; credit to American Museum and Henry Fairfield Osborn.

Trachodon mirabilis. Two well preserved skeletons of the Duckbill Dinosaur (closely related to the well-known Hadrosaurus) are shown, mounted together in lifelike pose. Upper Cretaceous Montana and South Dakota.

Mounted skeleton, Neg. 1092 (8 × 10 in.); Neg. 1093 (11 × 14 in.). Not published; right of reproduction reserved.

Restoration, Neg. R17 (8 × 10 in.). Published; credit to American Museum and Henry Fairfield Osborn.

Triceratops serratus. Palatal view of a fine skull of a three-horned dinosaur, about six feet long. Upper Cretaceous Montana.

Neg. 197 (8 × 10 in.); Neg. 198 (11 × 14 in.). Published; credit to American Museum and R. S. Lull.

Triceratops. Model of animal.

Neg. 196 (8 × 10 in.). Published; credit to American Museum and Henry Fairfield Osborn.

Stegosaurus. A herbivorous quadrupedal dinosaur with a small head and with the back arched and surmounted by vertical triangular plates of bone. Upper Jurassic, Wyoming.

Restoration, Neg. R48 (8 × 10 in.). Published; credit to U. S. National Museum and F. A. Lucas.

MAMMALS.

EDENTATA.

Propalæohoplophorus minor. Carapace of a small Glyptodont from the Santa Cruz Miocene of Patagonia.

Neg. 245 (8 × 10 in.); Neg. 246 (11 × 14 in.). Published; credit to American Museum and W. B. Scott.

Glyptotherium texanum. A North American (Texas) representative of the Glyptodonts of the South American Pleistocene.

Neg. 248 (with armadillo) (8 × 10 in.). Published; credit to American Museum and Henry Fairfield Osborn.

Metacheiromys tatusia. A Middle Eocene North American Armadillo.

Mounted skeleton, with armadillo. Neg. 814 (5 × 7 in.). Not published; right of reproduction reserved.

CARNIVORA CREODONTA.

Oxyæna lupina. A predaceous Creodont from the Lower Eocene of Wyoming, structurally ancestral to *Patriofelis*. In the restoration, an Oxyæna crouches over a prostrate Eohippus.

Mounted skeleton, Neg. 264 (8 × 10 in.); Neg. 265 (11 × 14 in.). Published; credit to American Museum and Henry Fairfield Osborn.

Restoration, Neg. R32 (8 × 10 in.). Right of reproduction reserved.

Patriofelis ferox. A jaguar-like Creodont of the Middle Eocene of Wyoming, with highly specialized shearing teeth and short clawed feet.

Mounted skeleton, Neg. 268 (8 × 10 in.); Neg. 270 (11 × 14). Published; credit to American Museum and Henry Fairfield Osborn.

Restoration, Neg. R1 B. Not published; right of reproduction reserved.

Mesonyx obtusidens. A large Middle Eocene Creodont, with heavy wolf-like skull, bluntly tuberculated cheek teeth, and feet of the compressed running type. The restoration shows a Mesonyx feeding upon the skull of a Uintatherium.

Restoration, Neg. R10 (8 × 10 in.). Published; credit to American Museum and Henry Fairfield Osborn.

Harpagolestes *sp.* A much larger animal than *Mesonyx*, with a skull as large as that of a Grizzly Bear. Upper Eocene, Uinta.

Skull Neg. 1096 (8 × 10 in.). Not published; right of reproduction reserved.

Hyænodon horridus. An Oligocene Creodont with a long skull, long shearing cheek teeth, and feet of cursorial type.

Mounted skeleton Neg. 289 (8 × 10 in.); Neg. 290 (11 × 14 in.). Not published; right of reproduction reserved.

Sinopa rapax. A more primitive relative of *Hyænodon*, from the Middle Eocene of Wyoming. *Sinopa rapax* Leidy was the first Eocene carnivore described from the United States.

Mounted skeleton, Neg. 1084 (8 × 10); Neg. 1085 (11 × 14 in.). Not published. right of reproduction reserved.

Apterodon *sp.* An Upper Eocene Egyptian representative of the Hyænodont family.

Skull, side view, Neg. 1097 (8 × 10). Right of reproduction reserved.

CARNIVORA FISSIPEDIA.

Borophagus ("Dinocyon") gidleyi. A great Amphicyonine dog of the Upper Miocene of Texas.

Skull and neck, Neg. 294 (8 × 10 in.). Published; credit to American Museum and W. D. Mathew. Restoration of head Neg. —. Not published; right of reproduction reserved.

Dinictis squalidens. A Sabre-tooth "Tiger" of the Oligocene epoch somewhat resembling the modern Cheeta (*Cynælurus*) in proportions and probably also in habits. In the spirited restoration a Dinictis is seen pursuing a Protoceras.

Mounted skeleton (partial), Neg. 296B (8 × 10 in.). Published, credit American Museum and W. D. Mathew.

Restoration, Neg. R38 (8 × 10 in.). Not published; right of reproduction reserved.

Hoplophoneus primævus. This genus was an Oligocene forerunner of the great Sabre-tooth "Tiger" of the Pleistocene epoch.

Mounted skeleton, Neg. 299 (6½ × 8½ in.).
Restoration, Neg. R22. Right of reproduction reserved.

Smilodon neogæus. This South American Sabre-tooth "Tiger" of the Pampæan Pleistocene is represented by exquisite photographs of the mounted skeleton and by a striking restoration.

Skeleton, Neg. 305 (8 × 10 in.); Neg. 308 (11 × 14 in.).
Skull, Neg. 310 (8 × 10 in.); Neg. 311 (11 × 14 in.).
Restoration, Neg. R 31A (8 × 10 in.).
Right of reproduction reserved.

CETACEA.

Prozeuglodon. Restoration of a genus of Cetaceans related to the Zeuglodonts of the American Eocene and believed to represent the ancestors of the existing Dolphins and Whales, from the Upper Eocene of Egypt.

Restoration, Neg. —. Right of reproduction reserved.

CONDYLARTHRA.

Phenacodus primævus. This is the lower Eocene genus that the late Professor Cope regarded as representing the five-toed "atavus" of all the hoofed mammals.

Mounted skeleton, Neg. 326 (8 × 10 in.); Neg. 328 (11 × 14 in.). Restoration, Neg. R20 (8 × 10 in.). Both published; credit to American Museum and Henry Fairfield Osborn.

Phenacodus wortmani. This smaller species of *Phenacodus* was contemporaneous with, and allied to, *Phenacodus primævus*.

Mounted skeleton, Neg. 332 (6½ × 8½ in.). Right of reproduction reserved.

Meniscotherium terrærubræ. This Lower Eocene Condylarth was distinguished from *Phenacodus* by the much more elaborate pattern of the cheek teeth.

Mounted skeleton, Neg. 1065 (8 × 10 in.); Neg. 1066 (11 × 14 in.). Not published, right of reproduction reserved.

AMBLYPODA.

Pantolambda bathmodon. This Basal Eocene forerunner of *Coryphodon* retains evidences of derivation from some Creodont-like ancestor in the arched back, long tail, skull with powerful jaws and occipital crest. The skeleton is so far the only mounted skeleton of a Basal Eocene mammal.

Mounted skeleton, Neg. 335 (8 ×10 in.); Neg. 336 (11 × 14 in.).

Mounted skeleton, (with *Coryphodon*), Neg. 342 (8 × 10 in.); Neg. 343 (11 × 14 in.).

Model (with *Coryphodon*) Neg. 334 (8 × 10 in.).

All published; credit to American Museum and Henry Fairfield Osborn.

Coryphodon testis. A Lower Eocene hornless Amblypod of Europe and America, a forerunner of *Uintatherium.* These pachyderms suggest the Hipopopotamus in the head and general proportions, but structurally were of a very different and archaic type.

Mounted skeleton (with *Pantolambda*, see above), Neg. 342 (8 × 10 in.); Neg. 343 (11 × 14 in.).

Model (with *Pantolambda*, see above), Neg. 334 (8 × 10 in.). Both published; credit to American Museum and Henry Fairfield Osborn.

Restoration, Neg. R 21 (8 × 10 in.). Right of reproduction reserved.

Uintatherium mirabile. The Uintatheres (Dinocerata of Marsh) of the Middle Eocene were the last and most specialized representatives of the small-brained, short-footed ungulate order Amblypoda. The long skull was surmounted by six bony protuberances; sabre-like canine tusks protruded from the upper jaw. The size was that of a large rhinoceros.

Mounted skeleton (of *Uintatherium mirabile*). Neg. 1070 (8 × 10 in.); Neg. 1071 (11 × 14 in.). Not published; right of reproduction reserved.

Restoration (of "*Loxolophodon*" *cornutus*), Neg. R 8 (8 × 10 in.). Published; credit to American Museum and Henry Fairfield Osborn.

EMBRITHOPODA.

Restoration of the great pair-horned *Arsinoitherium zitteli* of the Upper Eocene of Egypt. The animal is shown confronting a herd of the contemporary carnivores called *Pterodon.*

Neg. — (8 × 10 in.). Published; credit to American Museum and Henry Fairfield Osborn.

Arsinoitherium zitteli. Skull of a young individual of this great pair-horned pachyderm from the Upper Eocene of Egypt.

Neg. 1098 (8 × 10 in.). Right of reproduction reserved.

PROBOSCIDEA.

Mœritherium lyonsi. A very small and generalized structural ancestor of the elephants, scarcely falling within the limits of the order Proboscidea. Upper Eocene Egypt.

Skull, palatal view, Neg. 1104 (8 × 10 in.); side view, Neg. 1111 (5 × 7 in.). Right of reproduction reserved.

Palæomastodon wintoni and **Trilophodon productus.** Skulls (representing two stages in the evolution of the elephants) from the Upper Eocene of Egypt and the Upper Miocene of Texas.

Neg. 1039 (8 × 10 in.). Side view. Right of reproduction reserved. Published; credit to American Museum and Henry Fairfield Osborn.

Evolution of the Elephant. A group of restorations representing (1) *Mœritherium* and (2) *Palæomastodon*, ancestral Proboscideans from the Middle and Upper Eocene of Egypt, and (3) the Mammoth from the Pleistocene of the northern world.

Neg. — (8 × 10 in.). Published; credit to American Museum and Henry Fairfield Osborn.

Evolution of the head (tusks, trunk, etc.) in the Elephant. A group of restorations of the heads of *Mœritherium, Palæomastodon* and *Elephas* (Mammoth).

Neg. — (8 × 10 in.). Published; credit to American Museum and Henry Fairfield Osborn.

Trilophodon productus. A primitive four-tusked Mastodon from the Upper Miocene of Texas.

Skull and jaw, side view, Neg. 353 (8 × 10 in.). Not published; right of reproduction reserved.

Trilophodon productus and **Elephas imperator.** Models of two typical American Elephants, from the Miocene and Pleistocene respectively.

Neg. 368 (8 × 10 in.). Not published; right of reproduction reserved.

Mastodon americanus. The "Warren Mastodon" (mounted in 1907) is the most complete Mastodon skeleton known.

Skeleton, Neg. 1037 (8 × 10 in.).
Model, Neg. 1099 (8 × 10 in.).
Not published; right of reproduction reserved.

The "Whitfield Mastodon" is another well preserved skeleton.

Neg. 361 (8 × 10 in.); Neg. 364, mounting removed, (11 ×14 in.). Not published; right of reproduction reserved.

Elephas imperator. A very long pair of tusks and partly restored skull of the great Imperial Mammoth from the Pleistocene of Texas.

Skull and tusks, three quarters front view, Neg. 371 (8 × 10 in.). Published; credit to American Museum and Henry Fairfield Osborn.

Skull, palatal view with molars, Neg. 373 (8 × 10 in.). Right of reproduction reserved.

Model (see also *Trilophodon* above), Neg. 369. Published; credit to American Museum and Henry Fairfield Osborn.

Elephas columbi. A mounted skeleton of the Columbian Mammoth from the Pleistocene of Indiana, mounted in 1906. In this skeleton, as well as in the *Mastodon americanus* and *Elephas imperator* skeletons, the tusks are correctly mounted with the points turning more or less *inward.*

Mounted skeleton, Neg. 838 (8 × 10 in.). Published; credit to American Museum and Henry Fairfield Osborn.

HYRACOIDEA.

Megalohyrax. Restoration of a large Hyracoid from the Upper Eocene of Egypt, with figures of the modern Hyrax and Black Rhinoceros (*Rhinoceros bicornis*).

Neg. — (8 × 10). Published; credit to American Museum and Henry Fairfield Osborn.

ARTIODACTYLA.

Elotherium imperator. A giant suilline Artiodactyl from the Upper Oligocene of South Dakota.

Restoration, Neg. R 6. (8 × 10 in.). Published; credit to American Museum and Henry Fairfield Osborn.

Platygonus leptorhinus. A large Pleistocene Peccary from Kansas.

Mounted skeleton, Neg. 392 (8 × 10 in.); Neg. 393 (11 × 14 in.).
Restoration, Neg. R33 (8 × 10 in.).
All unpublished; right of reproduction reserved.

Hippopotamus madagascariensis. A skeleton of the Pigmy Hippopotamus of the Pleistocene of Madagascar is shown with a skull of a large *Hippopotamus amphibius.*

Neg. 395 (8 × 10 in.), 394 (11 × 14 in.). Not published; right of reproduction reserved.

Merycoidodon ("**Oreodon**") **culbertsoni.** Joseph Leidy, the discoverer of this well-known Oligocene genus, characterized it as a "ruminating hog." The cheek teeth are of the type seen in modern ruminants but the proportions of the body are more pig-like. The fore feet retain four complete digits and a reduced pollex, and thus in number as well as other characters realize the ancestral pattern of all even-toed hoofed mammals.

Mounted skeleton, Neg. 397 (8 × 10 in.); Neg. 396 (11 × 14 in.). Right of reproduction reserved.

Fore foot, Neg. 399 (4 × 5 in.). Published; credit to American Museum.

Merycochœrus proprius. A large block, containing the scattered remains of a bull and four calves of this species, illustrates the condition in which fossil mammals are sometimes unearthed. *Merycochœrus* was an even-toed hoofed mammal of the family Agriochœridæ ("Oreodontidæ") from the Miocene of the West. It was about as large as a pig, but with a more or less tapir-like proboscis and with cheek teeth of the ruminating type.

Neg. 400 (8 × 10 in.). Published; credit to American Museum and W. D. Mathew.

Promerycochœrus macrostegus. This John Day Oligocene Oreodont differed from *Merycochœrus*, especially in its more elongate skull without proboscis.

Skull and jaw, side view, Neg. 408 (8 × 10 in.) ; skull, palatal view, Neg. 409 (8 × 10 in.).

Both published; credit to American Museum and W. D. Mathew.

Alticamelus altus. Skull, neck and limbs of a large Giraffe-like Camel of the Middle Miocene of Colorado.

Neg. 417 (8 × 10). Published; credit to American Museum and W. D. Mathew.

Protoceras celer. In this curious six-horned deer-like Artiodactyl of the Upper Oligocene of South Dakota the fore feet are of the primitive type, with four separate digits, while in the hind foot the number of toes is reduced to two.

Mounted skeleton, Neg. 419 (8 × 10 in.); Neg. 420 (11 × 14 in.). Right of reproduction reserved.

Restoration, Neg. R4 (8 × 10 in.). Published; credit American Museum and Henry Fairfield Osborn.

Restoration (with *Dinictis*), Neg. R 38 (8 × 10 in.). Not published; right of reproduction reserved.

Merycodus osborni. This delicately formed Miocene "deer-antelope" combined characters of the modern deer and antelopes, since it bore a pair of deciduous antlers like those of deer, but in its skull, teeth and skeleton resembled the antelopes.

Mounted skeleton, Neg. 427 (8 × 10 in.); Neg. 426 (11 × 14 in.). Published; credit to American Museum and W. D. Mathew.

Cervalces americanus. This American Pleistocene genus combined characters of the Moose (*Alces*) and of the Wapiti or "American Elk" (*Cervus canadensis*). It is distinguished from both by its peculiar antlers, which branched in three planes: outward, forward, and upward.

Restoration, Neg. R19 (8 × 10 in.). Right of reproduction reserved.

Megaceros hibernicus. A careful and beautiful restoration of the Irish Elk of the Pleistocene of Great Britain.

Restoration, Neg. R26B (8 × 10 in.). Right of reproduction reserved.

PERISSODACTYLA.

Adaptive radiation of the molar teeth in the Perissodactyla. In the centre of a series of concentric circles representing the different epochs from Eocene to Recent, is placed a small restoration of *Phenacodus primævus* which represents the probable appearance of the common ancestors of all the odd-toed hoofed mammals. From this radiate lines of fossil teeth showing the successive stages of modification in the Horse Tapir, Lophiodont, Rhinoceros and Titanothere families.

Neg. 1062 (8 × 10 in.). Right of reproduction reserved.

TITANOTHERIIDÆ.

Palæosyops robustus. This genus represents one of the Middle Eocene stages of evolution of the Titanothere family. The animal resembles a Tapir in proportions, but was larger and more robust, and lacked a long proboscis.

Mounted skeleton, Neg. 442 (8 × 10 in.); Neg. 444 (11 × 14 in.). Right of reproduction reserved.

Restoration, Neg. R11 (8 × 10 in.). Right of reproduction reserved.

Brontotherium gigas. The Titanotheres were the dominant pachyderms of the Oligocene epoch and the larger varieties exceeded the largest Rhinoceroses in size. Above the eyes (which were very far forward) were two bony outgrowths from the skull, which in the largest species formed a pair of broad, flattened "horns."

Mounted skeleton, Neg. 531 (8 × 10 in.); Neg. 532 (11 × 14 in.).
Restoration, Neg. R. 7 (8 × 10 in.).
Skull, Neg. 537 (8 × 10 in.).
Published; credit American Museum and Henry Fairfield Osborn.

Four genera of Oligocene Titanotheres. Models of heads of *Megacerops, Titanotherium, Brontotherium, Symborodon.*

Side, front and top views. Neg. 448 (8 × 10 in.). Right of reproduction reserved.

Heads of four genera of Eocene Titanotheres. Models of heads of *Palæosyops, Telmatherium, Manteoceras, Dolichorhinus.*

Side view, Neg. 1055 (8 × 10 in.).
Top view, Neg. 1056 (8 × 10 in.).
Right of reproduction reserved.

RHINOCEROTIDÆ.

Hyrachyus agrarius. This small Middle Eocene rhinoceros was of the light-limbed, swift-running type. It was more primitive than some later Rhinoceroses in retaining four toes in the fore feet and relatively simple, short-crowned cheek teeth.

Mounted skeleton, Neg. 1100 (8 × 10 in.); Neg. 1101 (11 × 14 in.). Right of reproduction reserved.

Hyracodon nebrascensis. This Oligocene successor of *Hyrachyus* was also of the swift-running type, but the cheek teeth have longer crowns and are more decidedly of the Rhinoceros type.

Restoration, Neg. R9 (8 × 10 in.). Published; credit to American Museum and Henry Fairfield Osborn.

Amynodon intermedius. An Upper Eocene hornless Rhinoceros with four toes in the fore-foot.

Mounted skeleton, Neg. 560 (8 × 10 in.); Neg. 561 (11 × 14 in.). Right of reproduction reserved.

Metamynodon planifrons. This Oligocene Rhinoceros, related to *Amynodon,* is thought to have been semiaquatic on account of its adaptative resemblances to the Hippopotamus.

Mounted skeleton, Neg. 1102 (8 × 10 in.); Neg. 1103 (11 × 14 in.).
Restoration, Neg. R5 (8 × 10 in.). Published; credit to American Museum and Henry Fairfield Osborn.

Cænopus occidentalis. This characteristic Rhinoceros of the Middle Oligocene of South Dakota, formerly referred to *Aceratherium* of the European Oligocene, is represented by a well preserved mounted skeleton. The number of toes in the fore and hind feet is reduced to 3–3 as in later Rhinoceroses, whereas in more primitive Rhinoceroses the formula is 4–3 as in other ancient types of Perissodactyla.

Mounted skeleton, Neg. 570 (6½ × 8½ in.). Not published; right of reproduction reserved.

Cænopus tridactylus. A successor of *Cænopus occidentalis,* from the upper portion of the White River Oligocene, approximately ancestral to the pair-horned rhinoceros *Diceratherium* of the Miocene epoch.

Mounted skeleton, Neg. 573 (8 × 10 in.); Neg. 574 (11 × 14 in.).
Restoration, Neg. R3 (8 × 10 in.).

Teleoceras fossiger. A very short-legged and stout-bodied Rhinoceros of the Upper Miocene, resembling the Hippopotamus in proportions. The narrow nasals probably bore a rudimentary horn.

Mounted skeleton, Neg. 577 (6½ × 8½ in.).
Restoration, Neg. R23 (8 × 10 in.).
Published; credit to American Museum and Henry Fairfield Osborn.

EQUIDÆ.

American Tertiary and Quaternary members of the Horse family. A group of outline restorations.

Eohippus, Lower Eocene, North America.
Orohippus, Middle Eocene, North America.
Mesohippus, Oligocene, North America.
Hypohippus, Middle Miocene, North America.
Neohipparion, Upper Miocene, North America.
Hippidion, Pampæan Pleistocene, South America.
Equus scotti, Pleistocene, North America.

Neg. — (8 × 10 in.). Right of reproduction reserved.

Evolution of the grinding teeth of the Horse family.

Euprotogonia (a Condylarth), Basal Eocene.
Eohippus, Lower Eocene.
Mesohippus, Oligocene.
Parahippus, Miocene.
Merychippus, Pliocene.
Equus, Pleistocene.

Neg. 599 (8 × 10 in.). Right of reproduction reserved.

Evolution of the hind foot in the Horse family.

Eohippus, Eocene.
Mesohippus, Oligocene.
Anchitherium, Miocene.
Neohipparion, Pliocene.
Equus, Pleistocene and Recent.

Front view, Neg. 600 (8 × 10 in.).
Side view, Neg. 601 (8 × 10 in.).
Published; credit to American Museum and Henry Fairfield Osborn.

Evolution of the fore foot in the Horse family, illustrated by comparison with the human hand in different positions.

Neg. 603 (4 × 5 in.). Published; credit to American Museum and Henry Fairfield Osborn.

Euprotogonia (a Condylarth), five toes; *Eohippus,* four toes; *Mesohippus,* three toes and a splint; *Neohipparion,* three toes; *Equus,* one toe and splints.

Eohippus ("**Protorohippus**") **venticolus.** This genus is the earliest American representative of the Horse family, from the Lower Eocene, with four toes on the fore foot and three on the hind foot.

Restoration, Neg. R2C (8 × 10 in.).
Model (three animals), Neg. 612 (8 × 10 in.).
Published; credit to American Museum and Henry Fairfield Osborn.

Eohippus ("**Protorohippus**") **venticolus**, with **Mesohippus bairdi.**

Mounted skeletons, Neg. 614 (8 × 10 in.). Published; credit to American Museum and Henry Fairfield Osborn.

Eohippus ("**Protorohippus**") **venticolus**, with **Hypohippus equinus.**

Mounted skeletons, Neg. 615 (8 × 10 in.); Neg. 616 (11 × 14 in.). Right of reproduction reserved.

Orohippus osbornianus Cope. A four-toed ancestor of the Horse from the Middle Eocene (Bridger) of Wyoming.

Mounted skeleton, Neg. 1063 (8 × 10 in.); Neg. 1064 (11 × 14 in.). Not published; right of reproduction reserved.

Eohippus ("**Protorohippus**") **venticolus** with **Equus scotti.**

Mounted skeletons, Neg. 617 (8 × 10 in.); Neg. 618A (11 × 14 in.).
Published; credit to American Museum and Henry Fairfield Osborn.

Eohippus ("**Protorohippus**") **venticolus,** model, with skull of modern horse.

Neg. 619 (8 × 10 in.). Published; credit to American Museum and Henry Fairfield Osborn.

Eohippus venticolus, skeleton with skeleton of Whippet hound.

Neg. 624 (8 × 10 in.). Published; credit to American Museum and Henry Fairfield Osborn.

Mesohippus bairdi. A three-toed Oligocene representative of the Horse family (with *Eohippus*).

Neg. 614 (8 × 10 in.). Published; credit to American Museum and Henry Fairfield Osborn.

Restoration, Neg. R 49 (8 × 10 in.). Not published; right of reproduction reserved.

Hypohippus osborni. A Middle Miocene representative of the Horse family, called the "Forest Horse," with well developed side toes, which would have been useful in progressing over soft or uneven ground, and with short-crowned cheek teeth that may point to a habit of browsing upon twigs and softer shrubs. The animal is about 3 feet, 4 inches high at the shoulders.

Skeleton, Neg. 635 (8 × 10 in.); Neg. 634 (11 × 14 in.).
Skeleton (with Eohippus) Neg. 615 (8 × 10 in.); Neg. 616 (11 × 14 in.).
Restoration, Neg. R40 (8 × 10 in.).
Right of reproduction reserved.

Neohipparion whitneyi. A light-limbed three-toed horse of the Upper Miocene of Texas. The slender side toes were much more reduced than in *Hypohippus*, and the general build was swift and graceful, like that of the modern deer and antelopes. The animal may have used its long-crowned cheek teeth in grazing on the plains.

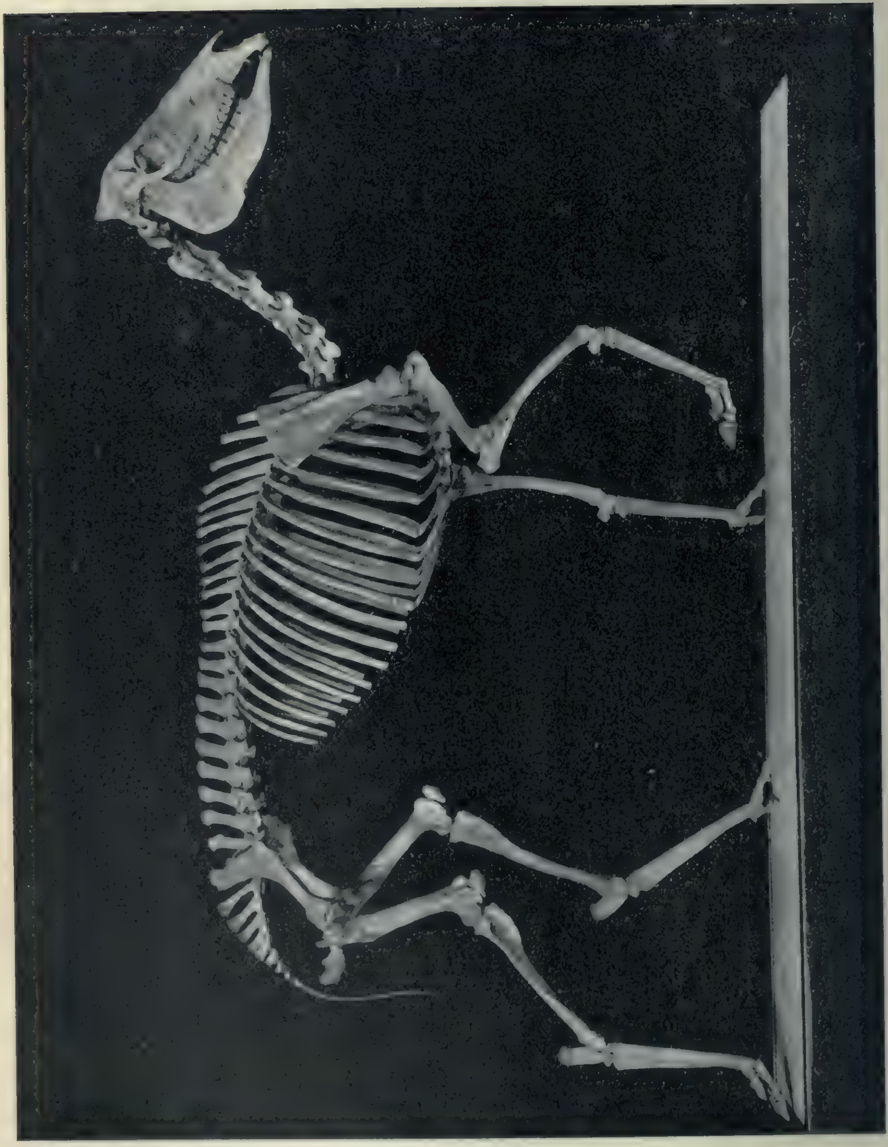


Fig. 2. Complete mounted skeleton of a three-toed horse (*Neohipparion whitneyi*) from the Miocene of South Dakota. Right of reproduction reserved.

Mounted skeleton, Neg. 644 (8 × 10 in.); Neg. 645 (11 × 14 in.). Right of reproduction reserved.

Restoration, Neg. R45 (8 × 10 in.). Right of reproduction reserved.

Equus scotti. An American Horse of the Pleistocene epoch, one of numerous native species which, so far as known, all died out before the advent of the white man in America.

Mounted skeleton, Neg. 658 (8 × 10 in.).

Mounted skeleton, (with *Equus scotti*) Neg. 617 (8 × 10 in.); Neg. 618A (11×14 in.).

Both published; credit to American Museum and Henry Fairfield Osborn.

Restoration, Neg. R50 (8 × 10 in.). Right of reproduction reserved.

Hippidion neogæum. A one-toed horse from the Pampæan Pleistocene of South America. This was a curiously stocky and short-limbed horse.

Cast of skeleton, Neg. 666 (8 × 10 in.).

Skull of a domestic Horse, prepared to show the teeth embedded in their sockets.

Neg. 771 (8 × 10 in.). Published; credit to American Museum and Henry Fairfield Osborn.

Skeleton of a Draught Horse.

Side view, Neg. 774 (8 × 10 in.); Neg. 775 (11 × 14 in.). Published; credit to American Museum and Henry Fairfield Osborn.

Skeletons of rearing horse and man.

Side view, Neg. 780 (8 × 10 in.); Neg. 781 (11 × 14 in.). Published; credit to American Museum and Henry Fairfield Osborn.

Skeleton of a very small adult Shetland Pony. Height at shoulder, 33⅜ inches.

Side view, Neg.— (8 × 10 in.). Right of reproduction reserved.

Skeleton of a desert bred Arab Horse.

Side view, Neg. 788 (8 × 10 in.). Right of reproduction reserved.

Skeleton of an American race horse, "Sysonby."

Side view, Neg. 1080 (8 × 10 in.); Neg. 1081 (11 × 14 in.). Right of reproduction reserved.

INDEX TO SUPPLEMENT.

Adaptive radiation, Perissodactyl molars, 12.
Allosaurus, 4.
Alticamelus, 11.
Amynodon, 13.
Apterodon, 6.
Arab horse, 17.
Arsinoitherium, 8.

Borophagus, 6.
Brontosaurus, 4.
Brontotherium, 12.

Cænopus, 13.
Carnivora, 6.
Cervalces, 11.
Champsosaurus, 2.
Coryphodon, 8.

Dimetrodon, 2.
Dinichthys, 2.
Dinictis, 7.
Dinocyon, 6.
Dinosaurs, 4, 5.
Diplodocus, 5.
Draught horse, 17.

Edentata, 5.
Elasmosaurus, 4.
Elephant, Evolution of, 9.
Elephas columbi, 10.
Elephas imperator, 9.
Elotherium, 10.
Eohippus, 14, 15.
Equus and Eohippus, 15.
Equus scotti, 15, 17.
Evolution Horse family teeth, limbs, etc., 14.

Glyptotherium, 5.

Harpagolestes, 6.
Hippidion, 17.
Hippopotamus, 10.
Hoplophoneus, 7.
Horse and Man, 17.
Horse, domestic, 17.
Horse family, 14.
Hyænodon, 6.
Hypohippus, 15.
Hyrachyus, 12.
Hyracodon, 13.

Ichthyosaurus, 4.
Irish Elk, 11.

Mammoths, 9, 10.
Mastodon, 9.
Megaceros, 11.
Megalohyrax, 10.
Meniscotherium, 7.
Merycochœrus, 11.
Merycodus, 11.
Merycoidodon, 10.
Mesohippus, 16.
Mesonyx, 6.
Metacheiromys, 6.
Metamynodon, 13.
Mœritherium, 9.

Naosaurus, 2.
Neohipparion, 16.

Oreodon, 10.
Ornitholestes, 4.
Orohippus, 15.
Oxyæna, 6.

Palæomastodon, 9.
Palæosyops, 12.
Pantolambda, 8.
Patriofelis, 6.
Perissodactyla, 12.
Phenacodus, 7.
Platygonus, 10.
Portheus, 2.
Promerycochœrus, 11.
Protoceras, 11.
Protorohippus, 14, 15.
Prozeuglodon, 7.
Propalæohoplophorus, 5.

Race-horse, 17.
Rhinoceroses, 12, 13.

Shetland Pony, 17.
Sinopa, 6.
Smilodon, 7.
Stegosaurus, 5.
Stereosternum, 2.
Sysonby, 17.

Teleoceras, 13.
Titanichthys, 2.
Titanotheres, 12.
Trachodon, 5.
Triceratops, 5.
Trilophodon 9.
Tylosaurus, 4.
Tyrannosaurus, 4.

Uintatherium, 8.

2515-4

BINDING SECT. SEP 12 1967

QH American Museum of Natural
1 History, New York
A4 Bulletin
v.24 1908

Biological
& Medical
Serials

PLEASE DO NOT REMOVE
CARDS OR SLIPS FROM THIS POCKET

UNIVERSITY OF TORONTO LIBRARY

STORAGE